

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY
AND ALLIED SCIENCES

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No 1

INCREASED IRRITABILITY OF THE GASTRO-INTESTINAL TRACT

A DISCUSSION OF DISTURBED PHYSIOLOGY¹

By B A RHINEHART, A B , M D , *Little Rock, Arkansas*

WITH the increasing perfection of roentgenologic methods of examining the gastro-intestinal tract, it has become well established that a large number of patients suffering from gastro-intestinal disorders are not the victims of organic lesions. As a matter of fact, some authors go so far as to say that, of all patients with gastro-intestinal diseases, those manifesting functional disorders are in the majority. The most common of the functional disorders is a condition of increased irritability of the muscles, and perhaps of the nerves, along the alimentary canal, resulting in demonstrable increased activities of dynamic, static, and postural nature. The term "increased irritability" is used for want of a standard diagnostic name. None of the many synonyms, such as nervous indigestion, simple colitis, mucous colitis, mucomembranous colitis, etc., has been generally accepted.

There is a growing opinion that the increased alimentary irritability is only part of a generalized physiologic disturbance. This may or may not be associated with demonstrable organic disease. A detailed survey of the symptoms given by those patients in whom gastro-intestinal examinations show hypermotility, localized and generalized spasticity with stasis, but no signs of organic disease, will disclose

many symptoms of increased muscular activity in other parts of the body. A complete history and roentgen examination of all patients with gastro-intestinal complaints will show that a third or more of them have a combination of organic lesions and generalized increased neuromuscular activity.

However, because an increased muscular activity of the alimentary canal may arise from simple stasis in the appendix or from other local points of heightened gradient, even the most careful questioning and a thorough appreciation of the interpretation of the various muscular spasms and cramps will not supplant a roentgen examination. Conversely, we may not expect to be able to find typical roentgen findings in all patients with abnormal irritability. In such cases the deciding evidence lies in the information derived from the history, and from tests for increased irritability of the neuromuscular system.

Increased activity of any of the muscles of the body may be present but, as a general rule, those muscles which are used most will be the first to cramp. Needless to say, it is not necessary for patients to have gastro-intestinal disorders with functional hyperactivity of other muscles. For example, paroxysmal tachycardia, bronchospasm, vasomotor spasm, or eclampsia are not always accompanied by gastro-intestinal spasm.

¹ Read before the Radiological Society of North America at the Twentieth Annual Meeting, Memphis, Tenn., Dec. 3-7, 1934.

have pointed out that most of the subjects of increased irritability of the gastro-intestinal muscles lead sedentary lives. Therefore, we may expect those muscles which are not skeletal to be the first involved. Included in this type are the gastro-intestinal muscles, the cardiac muscle, and the other muscles receiving their nerve supply from the autonomic system, such as the bronchial, arterial, uterine, bladder, and ureteral. The first skeletal muscles to be involved are usually those of posture, the most active groups of postural muscles being those in the neck and in the lumbar region.

The symptoms of extra-abdominal muscular irritability are as common as, and often more distressful than, those arising from the alimentary canal. Extra-alimentary muscular irritability is manifested in such frequent symptoms as breathlessness, smothering and choking, particularly at night, irregular or abnormally rapid heart action, uterine cramps, polyuria, paresthesias or anesthetics of the extremities, twitchings of the smaller voluntary muscles, and aching in the neck or lower back. In addition to the symptoms of increased muscular excitability, there are many instances of neuroses or dysfunction of the nervous tissues. From the combination of these two groups of manifestations, the term "nervous indigestion" has arisen. In the group of symptoms arising from the increased irritability of the nervous system are such reactions as reasonless laughing and crying, insomnia, anger, worry, restlessness, fear, slight fever, lowered basal metabolism, increased secretions, and increased reflexes. The nervous and muscular symptoms subside simultaneously, and there is evidence, which will be given later, that they are caused by the same chemical changes.

The symptoms of increased gastro-intestinal irritability are well known to roentgenologists and need not be repeated. However, one of the first symptoms to appear which has not received the attention it merits, is a feeling of distention or bloating in the upper abdomen, occurring after

a few swallows of food or water. Although stomachs vary greatly in size, I believe that I have observed a contraction of the antrum and a small fold of mucosa on the lesser curvature associated with this symptom. In the light of the knowledge of gastric anatomy and physiology derived from the writings of Cole, Alvarez, and Klein, this contracture seems to be a systole of the antrum, corresponding to systole of the cardiac ventricles and to the same type of contraction which occurs transiently in the course of normal gastric peristalsis. It seems probable that from this abnormal systole arises the pain so often mistaken for ulcer, although it comes sooner after meals and later at night.

So many excellent descriptions of the roentgenologic findings in patients with increased irritability have been given that a review of them is considered unnecessary. The roentgen-ray findings emphasize the beliefs of Pottenger and Charles Bolton that pain from the hollow abdominal viscera is due to increased muscular tension. The increased tension seems to be chiefly in the muscularis propria. I have been unable to find a description of increased tension in the muscularis mucosae. Although the function of the sphincteric muscle is tension, an increased postural activity of the sphincters of the colon may cause pain.

An increase in the tension of the muscles of the alimentary canal, sufficient to produce pain, may be caused by an abnormal reaction to a normal stimulus, or by an abnormal stimulus. Abnormal reaction to a normal stimulation occurs in hypersensitive states. Abnormal stimuli caused by local lesions, bulky diet, and irritating therapeutic measures, do not fall within the scope of this discussion except in their relationship to an irritative condition. In patients who have an excessive muscular reaction, it is important to recognize lesions which give rise to steepened gradient tumors, infections, ulcerations, obstructions, and stasis will do so. Stasis in a non-infected appendix may cause painful

tension in the entire colon Recently I observed such a case after an abnormal neuromuscular irritability had been corrected

Unfortunately, roentgenology will not show those changes described by McCarrison as being due to deficiencies in the food vitamins, unless ulcerative colitis and diverticulosis are advanced conditions of deficiency disorders However, it is probable that degenerative changes often accompany increased irritability

Although the roentgen findings in neuromuscular irritability of the alimentary canal are well known and the general manifestations can be elicited by careful questioning, possible etiologic factors are not so well understood Usually etiology is dismissed with the statement that it is a nervous condition However, researches on the stability of the nervous system have disclosed that the reason for increased irritability may be found in a chemical disturbance of the perfusion solution which bathes these spastic muscles and hyper-irritable nerves The researches show that it is usually the calcium part of the sodium-potassium-calcium ratio that is at fault, and that correction of calcium metabolism re-establishes the normal ratio

The perfusion solution is very important to the physiologist, working with a piece of muscle in his laboratory it must be just as important *in vivo* The physiologist controls the proportion of salts in his Locke's and Ringer's solutions by weight The same method is not feasible for the control of the same salts in the circulating blood and tissue fluids

During the early part of the last decade, it was discovered that Nature's method of controlling the inorganic salts in the body is by means of sunlight through the effect of ultra-violet radiation The effect of the visible and infra-red rays is not yet known Soon after the discovery of Vitamin D, the parathyroid glands were found to be the guardians of the storehouses of minerals in the bones In 1925, Collip reported the isolation of the active principle of these glands To-day, there is more known about Vitamin D and its physio-

logic activities than about any other vitamin, yet the practical application of this knowledge has not been fully utilized Several investigators have shown that a blood calcium determination is not sufficient to ascertain the state of calcium metabolism, and that the quantity of calcium in the circulating blood does not denote whether the calcium stream is toward the bones or away from them Manifestly, depletion of the storehouse is undesirable and will eventually result in disaster

In addition to correct methods of control of the inorganic salts in the blood stream, constant sources of supply are essential Sherman says that a larger proportion of ordinary dietaries are deficient in calcium than in any other one chemical element He gives the human requirement of calcium as nearly a gram each day This quantity can be satisfactorily obtained only from milk and cheese In a New York hospital, Bernheim found two patients out of 4,000 whose diet gave an adequate supply of calcium These two patients were in the hospital as a result of injury and not disease Bernheim believes that the importance of calcium in human nutrition and health seems far greater than is commonly realized Calcium constantly is being excreted from the body in the urine and feces There is an especially heavy drain on women because of menstruation, pregnancies, and lactation This may be the cause for the greater number of digestive disturbances in women than in men

Some of the points on mineral metabolism brought forth by J B Orr, in his Presidential Address before Section M of the British Association for the Advancement of Science, in 1925, are as follows

1 From 10 to 25 per cent of living matter consists of organic compounds from which the colloidal material of the protoplasm is formed The remaining 75 to 90 per cent consist of water and inorganic salts The true basis of protoplasm is the saline solution which forms from 75 to 90 per cent of its bulk and which still re-

sembles the sea water from which it originated

2 In a real sense, protoplasmic activity is regulated by the action of the mineral elements in solution in the protoplasm or attached to its colloids. Thus, in the contraction of muscle, though the ultimate source of energy is the oxidation of organic compounds, the initiation of the process, the mechanism by which it is carried through, and the factors by which it is controlled, depend on the action of the ions and salts present, which involve changes in osmotic pressure and other physical forces

3 Mineral metabolism is more important than the metabolism of carbohydrates, fats, and proteins, for animals will die sooner from privation of minerals than from complete starvation

4 The results of experiments with unicellular organisms and with isolated organs, such as the perfused heart, have shown that slight alterations of any of the inorganic ions may accelerate, retard, or even reverse processes being carried out by means of the colloidal mechanism

5 In the animal body these changes in the concentration of the inorganic ions can be correlated with changes in the functions of the organs. Thus, all the organs regulated by the central nervous system depend for the integrity of their functions upon the maintenance of definite ratios of calcium, potassium, and sodium in the fluids within the nerve tissues. Changes in the relative proportions of these are accompanied by alteration in the excitability of nerve and in the irritability of muscle

6 Forster's experiments on the effects of feeding a diet from which mineral salts had been removed showed profound disturbances caused by relatively small losses of inorganic salts from the system. Signs of disturbance of the digestive organs appeared early. They were soon accompanied by increased excitability and weakness of the neuromuscular system. The central nervous system was also affected, as was

shown by the occurrence of convulsions and periods of drowsiness

7 The hyperexcitability which occurs in calcium deficiency can be explained by the influence of the ion concerned on the colloids of the tissues or on the permeability of the membranes

8 It has been shown recently that the supply of minerals in the food of the mother may have a profound influence on the vitality of the young at birth and for some time after, even when there may be no obvious effect on the mother

9 Some attention has recently been devoted to the question of an increased susceptibility to certain infectious diseases in cases of malnutrition due to deficiencies of minerals. Orr noted in feeding experiments that the mortality from intercurrent infections in the groups fed on diets which are ill-balanced or deficient in mineral matter is greater than in the other groups. Meigs has noted a similar increased incidence of diseases in cows fed on diets deficient in calcium

10 At the Rowett Institute, Orr found that when animals are subjected to the influence of ultra-violet rays the amounts of calcium and phosphorus absorbed from the intestine tend to be increased

11 By his discussion, Orr attempted to establish the fact that "the mineral elements play such an important part in the physiologic processes of the animal body that serious pathologic conditions develop when the supply in the food does not meet the requirements of the animals"

Following the ideas of Hess and other writers, it is apparent that correct mineral metabolism depends on intake, absorption, assimilation, balance, and conversion. Part of this metabolism is controlled by the effects of sunshine and the parathyroid hormone. However, neither of these will supplant intake and absorption. Time does not permit an elucidation of the various factors controlling absorption of food or medicinal calcium. However, the antirachitic or calcium and phosphorus-controlling vitamin cannot be obtained in sufficient quantities from food

The lesson derived from the foregoing investigations is that the increased irritability of nerve and the excitability of muscle such as we encounter in gastro-intestinal diseases appears to be the same as that originating from deficiencies of calcium and Vitamin D, particularly since the highest incidence of gastro-intestinal disturbances, along with that of rickets, is in the urban population

It is fortunate that we are able to recognize increased irritability by means of a delicate and reliable test. The hypersensitive state can be diagnosed by using the galvanic current to stimulate the peripheral nerves. It gives rise to a reaction known as Erb's phenomenon. Hess says that this electrical test is the final criterion in regard to the diagnosis of latent tetany. Occasionally, however, the test is negative and the diagnosis depends on therapeutic results.

Erb's phenomenon is elicited by shocking the median nerve with a small galvanic current. A large positive electrode, wet with salt solution, is placed over the upper arm or back and a small negative electrode over the median nerve at the wrist. Because results are obtained with a smaller shock, the cathode closure current is the one generally used. The smallest amount of current that will give a visible reaction of any of the muscles of the hand is determined. Using 45 volts, a contraction with from 5 to 7 milliamperes of current is considered normal. Because of discomfort to the patient, Winklestein does not use over 3 milliamperes. If a contraction is obtained with less than 3 milliamperes, latent tetany is present. The use of the electrical stimulation of nerves in all patients with gastro-intestinal diseases results in a surprisingly large number of abnormal reactions.

The two mechanical tests for tetany, Chvostek's and Trousseau's, are not so accurate nor as dependable as the electrical test. It appears unfair to attribute all of the clinical manifestations of increased gastro-intestinal irritability to errors in mineral metabolism. In other words, a close

parallelism between the chemical deficiency and the symptomatology does not always exist. Unnatural stimulation increases the severity of the abnormal reactions. According to Hurst, the secretion of excess mucus in the colon is a response to chemical and mechanical irritations to the already abnormally irritable sympathetic nerves. The most common of these irritants are physics, enemas, douches, suppositories, irrigations, and undigested food residues. Aggravation of the irritability occurs with such methods of excessive stimulation.

SUMMARY

Uncomplicated increased gastro-intestinal irritability, commonly known as nervous indigestion, simple colitis, mucous colitis, spasticity of the colon, etc., is a part of a general neuromuscular disorder. This condition appears to be the result of defects in the perfusion solution which bathes the muscles, nerves, brain, and spinal cord. Researches and investigations show that this deficiency is chiefly in the metabolism of calcium. The errors in calcium metabolism are due to insufficient supplies of calcium and Vitamin D, resulting in latent tetany. There are three important diagnostic measures: history, roentgen-ray examination, and tests for tetany.

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PROTRACTED EXTERNAL IRRADIATION IN THE TREATMENT OF NEOPLASMS OF THE MOUTH AND THROAT¹

A COMPARISON OF X-RAYS, 5-GRAM RADIUM PACK, AND 100-MILLIGRAM RADIUM PACK

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PURPOSE OF THE WORK

THIS presentation is a two-year clinical study² of the effect of protracted external irradiation upon neoplasms of the upper respiratory tract. It undertakes the following

(1) To compare the gamma rays produced by high voltage x-rays with those produced by radium from a purely clinical standpoint,

TECHNICS

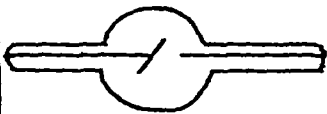

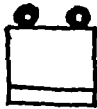
The three following technics were employed (Table I)

1 X-rays (Coutard Technic)

200 K V , 4 ma , 2 mm Cu and 1 mm Al filtration, 60 cm distance, 10 × 15 cm portal (150 sq cm)

The duration of treatments was from 18 to 28 days

TABLE I — TECHNICS EMPLOYED

	X-rays	Large radium pack	Small radium pack
			
	200 K V , 4 ma	5,000 mg	100 mg
Filtration	2 mm Cu and 1 mm Al	0.5 mm Pt and 5 mm Pb (6 mm Pb equivalent)	2.5 mm Pt (5 mm Pb equivalent)
Distance	60 cm	6 cm	6 cm
Portal	10 × 15 cm (150 sq cm)	8 × 10 cm (80 sq cm)	7 × 9 cm (63 sq cm)
Dose			
Daily dose	200 to 250 r to each of two portals	5,000 mg-hr to one alternate area each day. This averages 2,500 mg-hr to each area daily	2,400 mg-hr to each of two portals
Duration	18 to 28 days	21 to 28 days	18 to 23 days
Total dose	3,400 to 4,400 r (equal to from 3.75 to 5 S E D) to each portal Measured with back-scattering	50,000 to 60,000 mg-hr (equal to from 3 to 3.5 S E D) to each area	40,000 to 45,000 mg-hr (equal to from 2.25 to 2.75 S E D) to each area

(2) To ascertain the optimum number of days for the administration of radiation,

(3) To ascertain the optimum number of hours per day during which rays may be administered,

(4) To define the indications for interstitial radiation

The time of each treatment was 45 minutes to produce 200 r. Two areas were treated each day, one in the morning and one in the afternoon.

The total dose was from 3,400 to 4,400 r to each of the two portals (measured with back-scattering). This is equivalent to from three and three-fourths to five skin erythema doses.

2 Five-gram radium pack

6 mm Pb filtration, 6 cm distance, 8 × 10 cm portal (80 sq cm)

The daily dose was 5,000 milligram-

¹ Read before the Fourth International Congress of Radiology Zürich 1934

² This study has been made possible through the grant of William Warner & Co., and the Schering and Glatz Research Fellowship.

hours Only one area was treated each day, this being equivalent to 30 per cent skin of a erythema dose

The time was from 28 to 30 days

The total dose was 50,000 mg-hr (3 S E D) to 60,000 mg-hr (3 5 S E D) to each of two areas

The grand total was 100,000 mg-hr to 120,000 mg-hr

3 Small 100-milligram radium pack

2.5 mm Pt filtration, 6 cm distance, 7 × 9 cm portal (63 sq cm)

The daily dose was 2,400 mg-hr to one or both sides of the neck, depending upon the use of one or two packs

The time was from 18 to 25 days

The total dose was from 43,000 to 60,000 mg-hr to each area

The x-rays were administered according to the Coutard technic The r were measured so as to include back-scattering The portal was kept constant in size in all treatments in order to maintain a constant technic for more accurate comparison, even though efficiency was occasionally sacrificed

A comparative group of cases, but not included in this series, was treated with x-rays filtered with 0.5 mm copper, giving the same number of r per day, all other factors being constant except the time duration of each treatment, which was shorter It was found that rays of this

quality produced an epithelitis and epidermitis, more intense and appearing earlier than that produced by rays filtered through 2 mm copper This excessive reaction diminished the total amount that could be administered to the patient As we shall see later, the largest quantity that was administered to any one patient, when 0.5 mm copper filter was used, was 2,750 r to each portal (measured with back-scattering), whereas, with the 2 mm copper filter, giving the same number of r per day, a total dose of 4,400 r was safely given (Table II)

The five-gram pack technic was designed to reproduce as closely as possible, in the same time of administration of incident radiation as the x-rays, equivalent biologic reactions of epithelitis and epidermitis, or, in other words, the same biologic dose It is appreciated that the radium pack portal measured 80 sq cm, the most efficient size that would include the local lesion and the regional lymph nodes in the largest majority of cases, as compared with the 150 sq cm portal for the x-rays Furthermore, the focal skin distance of the radium pack is 6 cm as compared with 60 cm for the x-rays Expediency dictated these discrepancies Consequently the depth dose of the radium pack is much smaller, being about one-third that of the heavily filtered x-rays When the 5-

TABLE II — REACTIONS FROM X-RAYS (200 K V)

Number of treatment days	Total Dose in r (c scat)	Epithelitis				Epidermitis			
		Begin	End	No of days	Intensity	Begin	End	No of days	Intensity
0.5 mm Copper									
16	5 150	10	30	20	1 1/2°	13	33	20	2°
2 mm Copper									
22	8 400	13	39	26	1 3/4°	17	42	25	2°

TABLE III — "DESTRUCTIVE PHASE" OR "OPTIMUM TIME DURATION" FOR DIFFERENT WAVE LENGTHS

X ray quality	X-rays	X rays	Radium Gamma Rays
	200 K V 0.5 mm Cu and 1 mm Al w.l — 0.16 Å U h.v.l — 0.92 mm Cu	200 K V 2 mm Cu and 1 mm Al w.l — 0.11 Å U h.v.l — 1.8 mm Cu	6 mm Pb filter w.l — 0.01 + Å U h.v.l — 12.5 mm Pb
Optimum time duration	16 to 18 days	21 to 25 days	28 to 30 days

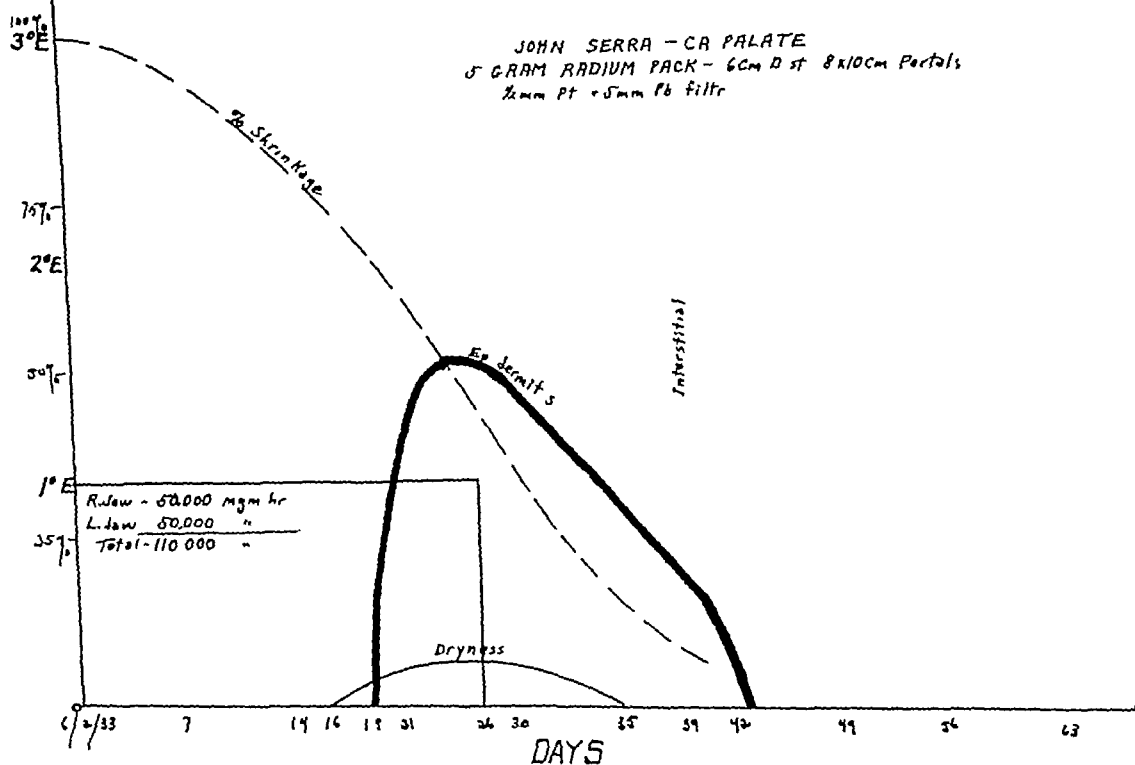
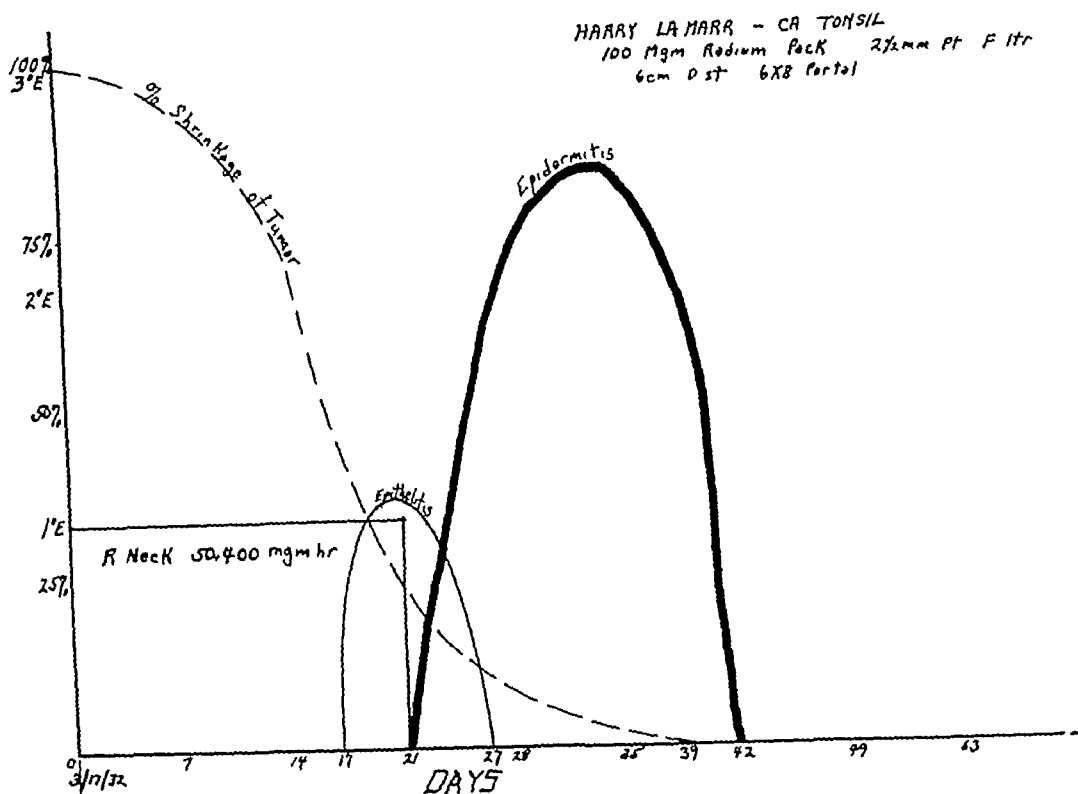


Fig 1 Graphic records of reactions Above tumor shrank 50 per cent in 16 days and completely as a result of the external radiation alone. Below tumor required 3 1/2 weeks to shrink 50 per cent Supplementary interstitial radiation was given as soon as mouth was comfortable, and while the shrinkage was on the down-grade, and required only a small dose

gram pack was applied to the skin in one sitting, lasting three and one-half hours, the incident dose of 17,500 mg-hr produced a threshold erythema. Each daily treatment lasted one hour, giving a dose of 5,000 mg-hr (30 per cent S E D) to only one of the two portals each day. The portals being alternated on successive days, this gave an average of 2,500 mg-hr a day to each portal as compared with the 2,400 mg-hr given to each portal with the small 100-mg pack.

The small pack technic duplicated all the factors of the five-gram pack except the quantity of radium, which was 100 milligrams for each pack. In order to deliver the same daily dose as the five-gram pack, the exposure was carried out for 24 hours a day. The radium tubes were placed within a slightly smaller portal in order to compensate for the increased field and consequently increased back-scattering in the tissue depths because of the unconfined beam. In the large pack, the beam was sharply defined by lead walls.

For the sake of constancy throughout the entire study, only two lateral portals were employed in every case, with occasional exceptions in cases in which the extensive involvement of the cervical nodes would not fit within the area of the portal. These cases were not included in the series. After experimenting with many devices, the small pack, which is best held in place by bandage rather than fixation apparatus, was finally made up of a small cardboard box, 5 cm high, with an additional 1.5 cm of rubber sponge at the bottom to accommodate itself to the irregularities of the lobe of the ear and the angle of the jaw, thus avoiding pressure necrosis. The rubber sponge is compressed down to a thickness of 1 cm, making a final skin-radium distance of 6 centimeters. Undoubtedly, the slight pressure ischemia from the weight of the pack tends somewhat to diminish the epidermitis. The shoulders are protected with lead plates, 1 cm thick. The pack is removed for a few hours every five days in order to give the patient a rest, and to clean the skin. The preferable

time for treatment for rays of this quality is 28 days, but this can seldom be carried out because the epidermitis will not permit the continued pressure of the pack after the twenty-third day.

During the course of the treatment, all patients are continuously observed and the intensity of the reactions of the skin and mucosa as well as the rate of shrinkage of the tumor are graphically recorded. These recordings are made thrice weekly, and all deductions reported herein are drawn from these graphs (Figs 1 and 1-A).

TIME DURATION OF TREATMENTS

When a full erythema dose of radiation is administered in one treatment, an erythema appears, reaches its peak, and then subsides. The "destructive phase" of this phenomenon is in progress from the time the treatment is given to the peak of the erythema. Following this, the "healing phase" ensues. This is accompanied by fibrosis, repair, and increased radioresistance. Each ray quality has its own characteristic time for the duration of the destructive phase (Table III).

(1) X-rays, which have an effective wave length of 0.16 Å U and a half value layer of 0.92 mm Cu (200 K V, 0.5 mm Cu filtration), when given in a single dose, produce an erythema which reaches its peak in approximately from 16 to 18 days. When these rays are administered at the same rate of 200 r per day as those filtered with 2 mm Cu, the reaction becomes so intense by the sixteenth day that no further treatment can be given. As mentioned before, this curtails the total quantity that can be given to only 2,750 r with this longer wave length ray, as compared with 4,400 r to each portal with the shorter wave length ray. Consequently, we postulate from 16 to 18 days as the optimum time duration for the administration of protracted external irradiation with rays of this quality.

(2) X-rays produced according to the Coutard technic (200 K V, 2 mm Cu filtration) with an effective wave length of 0.11 Å U, and a half value layer of 1.8

mm Cu, have a "destructive phase" or an "optimum time duration" of approximately 21 to 23 days. This is additionally verified by the fact that, if treatments are prolonged too far beyond this time, the

Any radiation that is administered later than the customary 3 or 4 weeks is directed at a tissue which is now rendered capable of not only resisting the destructive effect of the rays, but also of undergoing

RANK HANSFORD - CA PALATE
X-RAY - 200 KV, 5MA, 50 cm Dist,
1/2 Cu 2 RI filter 18 cm Portal

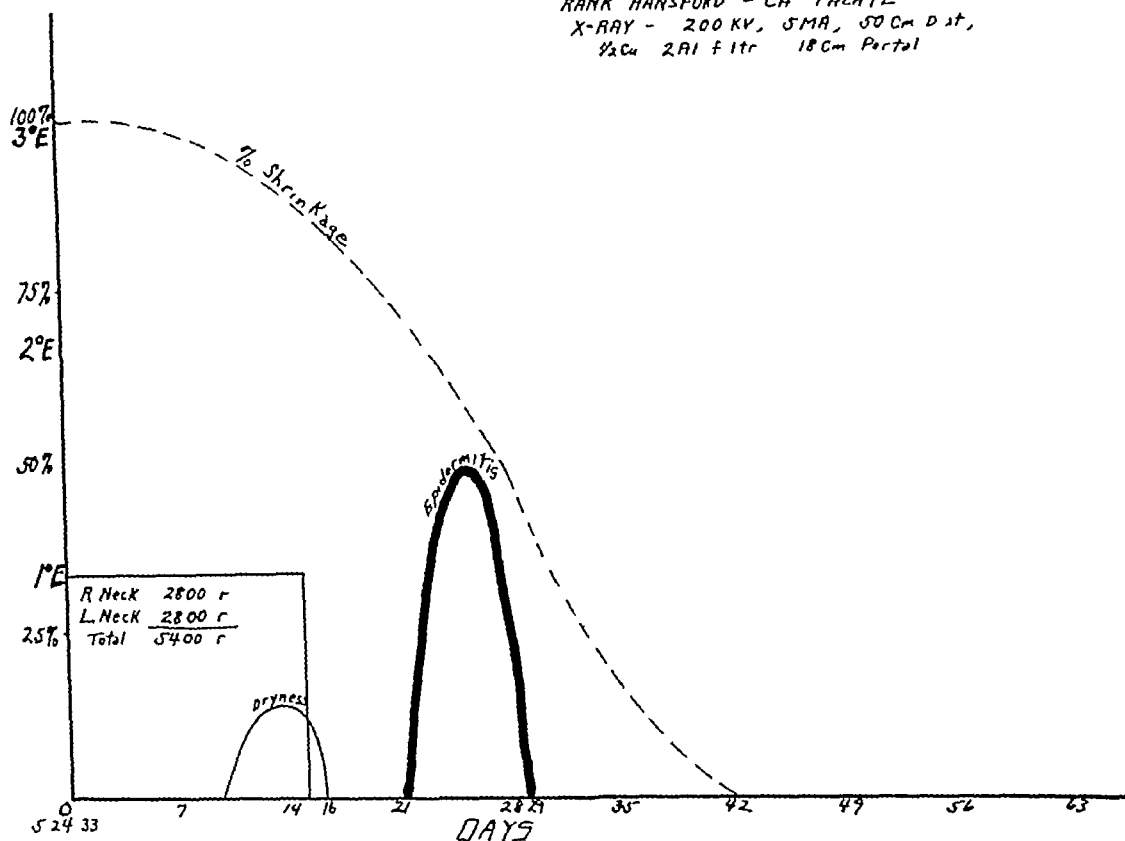


Fig 1 A Small dose of external radiation as evidenced by the light reactions, which did not overlap. Lesion shrink slower than 50 per cent in 14 days, and even though there was complete primary regression it recurred several months later and required a large dose of interstitial radiation which produced a severe prolonged reaction.

reactions are less intense. This indicates a diminished effect of the rays upon the biologic target, *i e*, skin, mucosa, and tumor. The epidermitis may even subside and heal though treatments are being administered currently.

Our experiences confirm those of Coutard in permitting the conclusion that the most effective type of protracted external radiation is that which will produce an epidermitis and an epidermitis of second degree intensity, wherein the epidermitis appears from 5 to 7 days before the epidermitis, and terminates in the same order. The reactions should be overlapping. Coutard believes they should be consecutive.

reparative fibrosis while under bombardment. The acquired radioresistance of the cells at this stage (*i e*, about one month after the onset of the treatment) is enormous. Grossly, the previous soft mass of the tumor which offered no resistance to puncture with a radium needle or other instrument is now converted into a tough, hard mass which is difficult to penetrate with a radium needle. The few remaining cells now locked in a dense fibrous stroma can easily resist any type of external radiation. Therefore, increasing the total dose much above 8,800 r when treatments have unavoidably been extended

gram pack was applied to the skin in one sitting, lasting three and one-half hours, the incident dose of 17,500 mg-hr produced a threshold erythema. Each daily treatment lasted one hour, giving a dose of 5,000 mg-hr (30 per cent S.E.D.) to only one of the two portals each day. The portals being alternated on successive days, this gave an average of 2,500 mg-hr a day to each portal as compared with the 2,400 mg-hr given to each portal with the small 100-mg pack.

The small pack technique duplicated all the factors of the five-gram pack except the quantity of radium, which was 100 milligrams for each pack. In order to deliver the same daily dose as the five-gram pack, the exposure was carried out for 24 hours a day. The radium tubes were placed within a slightly smaller portal in order to compensate for the increased field and consequently increased back-scattering in the tissue depths because of the unconfined beam. In the large pack, the beam was sharply defined by lead walls.

For the sake of constancy throughout the entire study, only two lateral portals were employed in every case, with occasional exceptions in cases in which the extensive involvement of the cervical nodes would not fit within the area of the portal. These cases were not included in the series. After experimenting with many devices, the small pack, which is best held in place by bandage rather than fixation apparatus, was finally made up of a small cardboard box, 5 cm high, with an additional 1.5 cm of rubber sponge at the bottom to accommodate itself to the irregularities of the lobe of the ear and the angle of the jaw, thus avoiding pressure necrosis. The rubber sponge is compressed down to a thickness of 1 cm, making a final skin-radium distance of 6 centimeters. Undoubtedly, the slight pressure ischemia from the weight of the pack tends somewhat to diminish the epidermitis. The shoulders are protected with lead plates, 1 cm thick. The pack is removed for a few hours every five days in order to give the patient a rest, and to clean the skin. The preferable

time for treatment for rays of this quality is 28 days, but this can seldom be carried out because the epidermitis will not permit the continued pressure of the pack after the twenty-third day.

During the course of the treatment, all patients are continuously observed and the intensity of the reactions of the skin and mucosa as well as the rate of shrinkage of the tumor are graphically recorded. These recordings are made thrice weekly, and all deductions reported herein are drawn from these graphs (Figs 1 and 1-A).

TIME DURATION OF TREATMENTS

When a full erythema dose of radiation is administered in one treatment, an erythema appears, reaches its peak, and then subsides. The "destructive phase" of this phenomenon is in progress from the time the treatment is given to the peak of the erythema. Following this, the "healing phase" ensues. This is accompanied by fibrosis, repair, and increased radioresistance. Each ray quality has its own characteristic time for the duration of the destructive phase (Table III).

(1) X-rays, which have an effective wave length of 0.16 \AA U and a half value layer of 0.92 mm Cu (200 K V, 0.5 mm Cu filtration), when given in a single dose, produce an erythema which reaches its peak in approximately from 16 to 18 days. When these rays are administered at the same rate of 200 r per day as those filtered with 2 mm Cu , the reaction becomes so intense by the sixteenth day that no further treatment can be given. As mentioned before, this curtails the total quantity that can be given to only 2,750 r with this longer wave length ray, as compared with 4,400 r to each portal with the shorter wave length ray. Consequently, we postulate from 16 to 18 days as the optimum time duration for the administration of protracted external irradiation with rays of this quality.

(2) X-rays produced according to the Coutard technique (200 K V, 2 mm Cu filtration) with an effective wave length of 0.11 \AA U , and a half value layer of 1.8

adjacent bones. However, if we wait longer than from five to six weeks for the interstitial radiation, a much larger dose will have to be given to the same volume of tissue, which is now more radioresistant and less tolerant.

Occasionally the residual tumor is still very extensive and a large dose of interstitial radiation must be given, so that the anticipated reaction will be severe. Or else, after a full course of external irradiation, the tumor does not shrink as expected, and interstitial radiation must be given. In this event, two weeks after the needle insertion, when the severity of the reaction is commencing to subside, extensive débridement is performed by electrosurgery. This hastens the eventual healing and shortens the period of debility due to absorption of necrotic material.

This operation is preceded, wherever possible, by preliminary regional nerve block with alcohol injections, which serves not only to provide anesthesia for the operation, but also to anticipate and mollify the pain from the subsequent osteitis and osteomyelitis.

This problem of interstitial radiation is important because it is our general impression that exclusive protracted external irradiation seldom entirely eradicates the more common radioresistant carcinomas or the advanced lesions. Very often, there remain impalpable residual cancer cells locked up in fibrous tissue for several years only to break through this wall and grow again or produce metastases in un-

usual sites. This residual tissue must be destroyed by interstitial radiation, electrocoagulation, or both.

DURATION OF DAILY TREATMENT

Ideal irradiation is that which is administered continuously for 24 hours a day over the longest effective time period. This cannot be done with x-rays, so, therefore, a compromise is made whereby the patient is exposed to x-rays for 15 hours a day, and permitted to rest during the remaining 22.5 hours. To increase the efficiency of this irradiation, one must decrease the rest period. The small 100-milligram pack accomplishes this by giving in 24 hours approximately the same dose that the five-gram pack gives in one hour, i.e., 2,400 milligram-hours per area.

A comparison of the reactions (Table IV) indicates that the double small pack, with a dose of 43,000 milligram-hours to each area, gives a slightly less intense epithelitis, but a more intense epidermitis than the large pack, giving a dose of 55,000 milligram-hours to each of two areas over a similar period of time.

In Table V, we note that a five-gram pack, giving a dose of 56,000 mg-hr to each of two areas (line 6), when compared with a single small pack giving the same dose in the same period of time to only one area (line 12), will produce practically the same intensity of epithelitis and epidermitis, though of a longer duration. When comparing the doses of threshold

TABLE IV—SUMMARIZATION OF REACTIONS PRODUCED BY DIFFERENT TECHNIQS

The upper box containing the three small pack notations demonstrates the regularity and constancy of the increase in intensity and duration of the reactions with the increase in dose. Neither of the other two techniques were as consistent. See text for explanation of lower two rows.

No treatment days	Dose in mg hr	Epithelitis				Epidermitis			
		Begin	End	No of days	Intensity	Begin	End	No of days	Intensity
Single Small Pack									
21	50 000	14	25	11	1½°	19	42	23	2¼°
23	55 000	17	29	12	2°	23	53	30	2°
25	59 500	16	38	22	2°	24	46	21	2°
Double Small Pack									
19	43 000	11	28	17	1½°	16	38	22	2¼°
5 Gram Pack (short duration) Two Areas									
21	55 000	11	33	22	2°	14	35	21	1½°

beyond 21 days does not seem to influence the response of the tumor

If the duration of the treatments is too short, there results an increase in the severity of the epitelitis and epidermitis, with a prolongation and intensification of these reactions. This necessitates a curtailment of the total dose administered

(3) Radium gamma rays, of 0.01 \AA U effective wave length, and with a half value layer of 12.5 mm lead, at 6 cm distance will produce a threshold erythema with a dose of 17,500 mg-hr. The latent period varies from 4 to 6 weeks. The peak of the erythema may not be reached for from 6 to 8 weeks. This inconstancy renders the observation of the threshold erythema less reliable in the determination of the "optimum time duration" for this quality ray, than the observance of the appearance of the reactions during the course of the treatments. It is found that the "destructive phase" for the gamma ray lasts from 28 to 30 days, after which time the tumor is so altered as to become very markedly resistant to further influence. Slight variations in the number of days of treatment cause definite changes in the responses of the patient and his tumor.

It is acknowledged that neoplasms of different degrees of malignancy have characteristic rhythms of growth and optimum times of response to radiation. It appears however, that this factor of growth rhythm may be equalled in importance by the temporal rate of effectiveness of the ray quality employed.

INTERSTITIAL RADIATION

In this series are included all types of carcinomas of the mouth and throat, of varying degrees of malignancy. Many of them are not completely destroyed by the external irradiation, and require interstitial irradiation.

Following protracted external irradiation, the tumor bed has been so modified by the resultant increased fibrosis that it cannot tolerate the interstitial radiation as well as non-irradiated tissue can. The

subsequent radium reactions are prolonged, painful, and frequently never heal spontaneously. Furthermore, any bone that comes within range of the interstitial radiation rapidly breaks down, and becomes the seat of prolonged osteomyelitis.

We have observed in this series that if a lesion shrinks 50 per cent in from 14 to 16 days after the onset of the treatment, it will usually disappear completely as a result of the external radiation alone. If it is not so radiosensitive as this, then its selective sensitivity is too close to normal tissue to permit protracted external irradiation alone to be effective. There will be a residuum or a recurrence for which interstitial radiation will have to be delivered at some time or other. Occasionally a lesion which shrinks at the rate of less than 50 per cent in from 14 to 16 days will eventually disappear completely just from external irradiation alone, but, in our series, every case of this nature eventually recurred, sometimes one year later (Figs 1 and 1-A).

If we wait until the external radiation has been fully delivered and the reactions from it subside (*i e*, from five to six weeks) before inserting needles or seeds, the tumor bed will have been so modified by fibrosis that the resultant radium reaction will be considerably prolonged and debilitating. Furthermore, a larger dose of interstitial radiation than usual will be required because the desmoplasia has increased the radioresistance.

Therefore, at the end of from 14 to 16 days of protracted external radiation, every case is carefully analyzed. If the shrinkage is less than 50 per cent, the external radiation is abruptly terminated so as not to modify the tumor bed any further, and interstitial radiation administered as soon as the comfort of the mouth permits. Since the tumor is still actively regressing, and the fibrosis of repair has not yet set in to any great extent, only a small dose of interstitial radiation is required to destroy the remaining tumor. The resultant reaction is gratefully tolerated by the patient, the tumor bed, and the

very much longer in comparison with the former

Consequently, when the demands of economy necessitate a sacrifice in any factor, the time factor of each treatment may be reduced with the smallest clinical sacrifice as far as x-rays are concerned. We still acknowledge the great importance of administering one treatment in the morning and one in the evening, thereby splitting in half the time during which the cells are recuperating from the radiation effect.

These deductions are offered presumptively because of the uniformity of the time of appearance of the reactions, their overlapping, and their intensity with the small pack technic. It is impossible for the patient to miss an appointment because of a holiday or week-end, since the pack is always upon him, and the experimental error is much less than with the Coutard and five-gram pack technics.

COMPARISON OF X-RAYS AND RADIUM GAMMA RAYS

When protracted external irradiation with x-rays of 200 K V filtered with 2 mm Cu, and radium gamma rays filtered with 6 mm lead is administered for the same period of time according to the above technics, and in such quantities as to produce epithelitis and epidermitis of equivalent intensity and duration, there is noted no significant difference in the effect of these two rays upon the tumor.

In terms of the threshold skin erythema dose, utilizing 960 r as the erythema dose for x-rays, and 17,500 mg-hr as the erythema dose for the radium gamma rays, it required 4.5 S E D of x-rays to produce the same effect as 3.5 S E D of radium gamma rays delivered by the large pack.

Gamma rays of radium produce a more profound effect upon normal tissues around the tumor than x-rays, rendering them less able to withstand subsequent interstitial radiation. The reactions from the interstitial treatment following radium pack are more severe, and the incidence and severity

of the osteitis and osteomyelitis are greater. Finally, as noted before, a single skin erythema dose produced with x-rays appears earlier than the one produced with radium rays, and lasts for a shorter period of time.

CONCLUSIONS

1 There appears to be very little appreciable difference in the primary effect upon the tumor between x-rays and radium gamma rays as employed in this series.

2 The differences between the two types of rays which do occur are as follows:

(a) The erythema from a single skin erythema dose of radium gamma rays appears at a much later time and is more prolonged than that from x-rays.

(b) Gamma radium rays produce a more profound effect upon the normal tissues around the tumor, rendering them less well able to tolerate subsequent interstitial radiation.

(c) The maximum amount of radiation over the same period of time and causing the same intensity of biologic effect of epidermitis and epithelitis is produced by 3.5 S E D with the radium pack, and 4.5 S E D with x-rays.

3 The duration of the period of administration of the treatments is probably the most important single factor in protracted external irradiation. Each histologic type of neoplasm has its own rhythm of response and must be paralleled by a suitable time duration for the treatments. Furthermore, each type of ray quality has a characteristic period of greatest effectiveness, during which the destructive phase is in the ascendancy and the healing phase has not yet commenced. The proper delicate adjustment of these two factors is essential to efficient protracted irradiation.

4 The double small 100-milligram pack, producing continuous irradiation for 24 hours a day, is an efficient therapeutic medium which closely rivals the large five-gram pack. It appears to produce the same effect upon the skin and mucosa with only four-fifths of the dose given with the larger pack.

effectiveness of these two radium packs (lines 2 and 9), we see that 50,000 mg-hr with the single small pack will produce a 1.5 degree epithelitis and a 2.25 degree epidermitis, whereas the large pack, giving the same dose over two areas, will produce only a 0.25 degree epithelitis (dryness) and a 1.5 degree epidermitis.

The relatively small group of 14 cases treated with the small pack permits the formulation of only tentative conclusions as to the effect of continuous irradiation upon the tumor itself as compared with other techniques. Nevertheless, we have shown that the small pack, with only 80 per cent of the dose given with the large pack, will produce the same intensity of skin and mucosal reactions, and a slightly superior effect upon the tumor itself.

In terms of the skin erythema units, it requires from 3 to 3.5 SED of gamma radium rays delivered by the large pack to produce the same reactions and results as 2.25 to 2.75 SED delivered with the

small pack. The ratio of the time factor of each treatment for the two packs is 1 as compared with 24 hours a day. When expressed in terms of clinical effectiveness, the ratio is 4.5, or, in other words, the small pack will produce the same degree of biologic effectiveness as the large pack with only 80 per cent of the dose.

When this law is interpreted in the light of the factors in the Coutard x-ray technique, the use of 20 ma instead of the usual 4 ma produces only a slight decrease in the clinical effectiveness. The time required to administer the same dose of 200 r with these two factors to each of two portals daily is 20 minutes with 20 ma and 1.5 hours with 4 ma. The rest periods with these milliamperages is $23\frac{3}{4}$ and $22\frac{1}{2}$ hours per day, respectively. These are fairly equivalent times. Though the time duration of each exposure is important, we consider this rest period per day as having greater influence upon the effect of the treatment, because the latter is so

TABLE V—SUMMARY OF REACTIONS PRODUCED BY DIFFERENT TECHNIQUES

Each line represents the average of those cases in which the same dose has been given in the same number of days at the same rate. Note that a five gram pack (line 6) giving a dose of 56,000 mg-hr to each of two areas when compared with a single small pack (line 12) giving the same dose in the same period of time to only one area produces practically the same intensity of epithelitis and epidermitis though of longer duration. In line 2 the five gram pack is administered to two areas to produce a very mild epidermitis and epithelitis. The same dose when administered by a single small pack to only one area where there is no benefit of cross firing will produce a more intense epidermitis and epithelitis.

Number of treatment days		Dose in mg hr	Epithelitis				Epidermitis			
			Begin	End	No of days	Intensity	Begin	End	No of days	Intensity
5 gram Pack—Two Areas										
8	40 000	7	40	33	2½°	6	40	34	3°	
25	50 000	17	34	17	1¼°	18	41	23	1½°	
25	55 000	10	41	31	1¾°	17	45	28	2¼°	
27	60 000	8	39	31	2¼°	17	44	27	2¼°	
30	75 000	18	63	45	2¾°	18	62	44	2¼°	
Total										
24	56 000	12	43	31	2°	15	46	31	2¼°	
5-gram Pack—One Area										
17	52 000	13	25	12	1½°	16	40	24	1½°	
Small Pack—Two Areas										
19	43 000	11	28	17	1½°	16	38	22	2½°	
Small Pack—One Area										
21	50,000	14	25	11	1½°	19	42	23	2¼°	
23	55 000	17	29	12	2°	23	53	30	2°	
25	60,000	16	38	22	2°	24	46	21	2°	
Total										
23	55 000	15	31	16	2—°	22	47	25	2+°	

very much longer in comparison with the former

Consequently, when the demands of economy necessitate a sacrifice in any factor, the time factor of each treatment may be reduced with the smallest clinical sacrifice as far as x-rays are concerned. We still acknowledge the great importance of administering one treatment in the morning and one in the evening, thereby splitting in half the time during which the cells are recuperating from the radiation effect.

These deductions are offered presumptively because of the uniformity of the time of appearance of the reactions, their overlapping, and their intensity with the small pack technic. It is impossible for the patient to miss an appointment because of a holiday or week-end, since the pack is always upon him, and the experimental error is much less than with the Coutard and five-gram pack technics.

COMPARISON OF X-RAYS AND RADIUM GAMMA RAYS

When protracted external irradiation with x-rays of 200 K V filtered with 2 mm Cu, and radium gamma rays filtered with 6 mm lead is administered for the same period of time according to the above technics, and in such quantities as to produce epithelitis and epidermitis of equivalent intensity and duration, there is noted no significant difference in the effect of these two rays upon the tumor.

In terms of the threshold skin erythema dose, utilizing 960 r as the erythema dose for x-rays, and 17,500 mg-hr as the erythema dose for the radium gamma rays, it required 4.5 S E D of x-rays to produce the same effect as 3.5 S E D of radium gamma rays delivered by the large pack.

Gamma rays of radium produce a more profound effect upon normal tissues around the tumor than x-rays, rendering them less able to withstand subsequent interstitial radiation. The reactions from the interstitial treatment following radium pack are more severe, and the incidence and severity

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(c) The maximum amount of radiation over the same period of time and causing the same intensity of biologic effect of epidermitis and epithelitis is produced by 3.5 S E D with the radium pack, and 4.5 S E D with x-rays.

3 The duration of the period of administration of the treatments is probably the most important single factor in protracted external irradiation. Each histologic type of neoplasm has its own rhythm of response and must be paralleled by a suitable time duration for the treatments. Furthermore, each type of ray quality has a characteristic period of greatest effectiveness, during which the destructive phase is in the ascendancy and the healing phase has not yet commenced. The proper delicate adjustment of these two factors is essential to efficient protracted irradiation.

4 The double small 100-milligram pack, producing continuous irradiation for 24 hours a day, is an efficient therapeutic medium which closely rivals the large five-gram pack. It appears to produce the same effect upon the skin and mucosa with only four-fifths of the dose given with the larger pack.

ROENTGEN THERAPY IN SYRINGOMYELIA¹

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THE symptomatic relief following x-irradiation of a majority of a group of some thirty cases presenting the clinical syndrome of syringomyelia, treated in our clinic, has been so striking that it seems impelling to again bring this method of therapeusis to the attention of the English-speaking profession

An original paper by Merrill (40), in 1924, who treated one case of syringomyelia with x-rays at the Massachusetts General Hospital, together with a translation of Delherm and Morel-Kahn's (13) original French article, comprise the entire contribution on the subject in English to date

On the other hand, the roentgen therapy of syringomyelia has been practised rather generally on the Continent since the original communication of Raymond (46), in 1905, with favorable results

Sahatchieff (51), after studying the published cases up to 1912, estimated that in 80 per cent of the subjects suffering from syringomyelia improvement had followed roentgen therapy

Keijser (29), in 1926, reported 53 personal cases treated by x-ray, two-thirds of which showed a more or less subjective improvement which had lasted five years. Objective improvement occurred in only 15 cases of his group

Delherm and Morel-Kahn (13, 14) observed 15 cases, nine of which (about 60 per cent) were improved, one unchanged, and five aggravated

Czerny and Heimsman (12) published in 1930 their experience in the treatment of 124 cases of syringomyelia. Seventy of these had been observed for from two to

five years. Of this group, 75 per cent showed good results, 13 per cent were arrested, while 12 per cent progressed further. Most of their cases were in men occupied at hard labor in whom the disease existed for from one to twenty years. In their group were 12 cases of syringomyelia in which nystagmus, sensory involvement of the trigeminus, disturbances of speech and swallowing, dissociated sensibility and headache disappeared entirely. Motor disturbance of the trigeminus was not favorably influenced

These authors employed high voltage (180 K V , 25 ma , and 0.5 Cu plus 1 Al filter) at a 45° angle, one-half to three-quarters E S D , not more than one-quarter skin dose daily, repeated at an interval of from one to three months. Repetition of the treatment was only done when the skin was perfectly normal

Markow, Gorjelik, and Liwschutz (37), in 1932, reviewed critically 30 cases of their own. These comprised 25 males and 7 females from 10 to 55 years of age in whom the disease had existed for from one to over ten years. They also utilized high voltage therapy (170 K V , 35 ma , and 0.5 Cu plus 1 Al filter), but with vertical centralization of the rays over the affected vertebral segment, giving a 90 per cent E S D in three sessions with an interruption of only one day between the treatments. Such a series was repeated after six to eight weeks if necessary

In 15 of their cases the different obstinate paresthesias partially came back. In 17 cases pain decreased considerably and in five cases did not recur, in three cases they observed an enormous decrease of hyperhydrosis, and also in four cases the disappearance of cyanosis of the extremities. In four cases they were able to obtain a complete restitution of touch

¹ Read in part at the Annual Meeting of the Radiological Society of North America Atlantic City Nov. 29 1932 and at the Fourth International Congress of Radiology Zürich July 27 1934

sensibility The pain sense was compensated much better and more quickly than the temperature sense Of the various kinds of temperature sense, the sensation of cold was restored much better and more quickly than that of heat There was nearly complete restitution of muscle power in five of their cases and a considerable improvement in three others In six cases they observed restoration of the tendon reflexes In only five of their cases did the disease progress in spite of treatment

Giese and Ossinskaja (21) also, in 1932, published their observations on 128 patients treated by x-rays for syringomyelia There was a follow-up in 85 of their cases, 50 per cent of which showed permanent improvement Their technic was as follows 160 K V , 4 ma , 0.5 Cu plus 1 Al filter, field, 8×15 cm , distance, 30 cm , one-half to three-quarters E S D to each portal

The disease at the beginning of x-ray treatment in their cases had existed for from three months to twenty years Thirty-seven cases were classed as syringobulbia In these, there was also an associated lesion of the cervical and dorsal regions of the spinal cord It is their opinion that only rarely may one expect a favorable outcome from irradiation if, after the first series, there has been no improvement in the objective symptoms of the disease, because in such cases the anatomical lesions are probably too extensive

At the Boston City Hospital, since 1924, 30 cases have been treated by irradiation Each case was first seen by the neurologic service and referred with the diagnosis of syringomyelia In the group were 17 males and 13 females, divided in age groups as follows

Up to 30 years	5
30-40	8
40-50	5
50-60	7
60-65	5

The cervical and dorsal segments were indicated as the site of the lesion in the

majority of cases Two cases of the first age group had involvement of the brain stem and medulla as well as a cervical lesion—both of these did well after irradiation The improvement in patient M S , aged 11 years, was most striking He was disoriented and ataxic, he presented nystagmus, dysphonia, and dysphagia There was immediate improvement in his speech and gait, so that within a month he was discharged to his home and returned to school He did not return to the hospital to continue his x-ray treatments as directed, and he relapsed into his former condition and, following operative interference, died of pneumonia

In 19 (or $61\frac{1}{2}$ per cent) there was definite improvement—subjective, objective, or both—following irradiation If we omit four patients too ill to continue treatment or who did not, and two cases lost sight of, the group followed is reduced to 24, of which number 75 per cent were benefited There have been two deaths, one post-operative and the other from disease Of the 22 patients now living, there are five who at no time could see improvement and in whom the disease has progressed obviously Six of this series believed that the first few treatments aggravated their symptoms but all ultimately came into the improved group

The nature of the improvement has been unmistakable—such as the return of thermal sensation, cessation of pain, restitution of voluntary muscular movement of the arms and legs, disappearance of ataxia, with improvement in walking and normal locomotion for some, restoration of normal speech and deglutition, the healing of trophic ulcers, transformation from semi-invalidism to self-helpfulness, and in some cases replacement in gainful occupation

How x-irradiation acts to relieve symptoms in syringomyelia is problematical One may think of the relief of pain as due to the now well accepted "anesthetic effect" and of the relief of certain other symptoms as due to the now equally well

accepted "counter-irritant effect" of roentgen rays

Beaujard and Lhermitte (4), in 1907, reported some observations in animals sacrificed following irradiation. A degeneration of the fibers of the posterior cord and of the cells of the posterior horns, as well as ependymal hemorrhages, were noted in two guinea pigs, and in two others the histologic examination of the marrow did not show a single alteration. I have not found any observations as to changes noted post-irradiation in humans.

Certain it is that profound vascular changes, with death of tumor cells, have been observed in other conditions following intensive irradiation. Since glomatous tissue is made up of young cells in the process of evolution, one might well expect it to be radiosensitive. If the results observed in other newgrowths hold here, then all the glomatous cells will not be destroyed by irradiation. This may offer an explanation of the temporary arrest of the disease in some cases, later to be followed by its progression. If there has been degeneration of the fibers of the cord and destructive changes in the horns, it is hardly conceivable that irradiation will alter them.

An arrest of the disease may be hoped for if the symptoms are secondary to a limited area of gliosis, with inflammatory reaction, even in the presence of a cavity. If the cavity is an extensive one containing a large amount of fluid under pressure, it is possible that irradiation may increase the amount of fluid and aggravate the condition. This has been observed in the x-ray treatment of giant-cell tumors. On the other hand, these giant-cell tumors after liquefaction go on to organization if irradiation is continued, with a consequent cessation of pain. It is well recognized, too, that pleural effusions secondary to malignancy and abdominal ascites are absorbed, frequently following medium voltage x-ray therapy in relatively small doses. These facts are sufficient warrant for one to proceed with roentgen-ray therapy in those cases of syringomyelia

which, on analysis, would appear to be hopeless on account of the extent of the cavity.

The clinical syndrome of syringomyelia may result from many processes: a genuine tumor associated with cavity, a limited gliosis with a small cavity, an extensive gliosis with a cavity which may extend from the equina to the pons, a cavity filled with fluid under pressure, a long-standing quiescent congenital defect lighted up perhaps by trauma, with resultant hemorrhage and cavity formation, or a slowly progressing gliosis which may remain practically stationary for twenty years or more.

I do not believe the age of the patient or the duration of the disease militate against beneficial symptomatic relief so much as the character of the pathologic changes present which produce the syringomyelic syndrome. In our improved group were cases of five, eight, ten, and eleven years' duration. In our unimproved group was one case each with symptoms of one, three, six, and twelve months' duration.

X-ray treatment has been directed first to the area as localized by the neurologic service, and then the remaining portions of the cord and medulla were irradiated. This latter maneuver I think especially important in view of the extensive and bizarre forms the underlying pathologic process may assume.

The primary beam is directed toward the canal through alternate right and left oblique portals (30×10 cm). From necessity the early cases were treated with medium voltage, namely, 145 K V, 5 ma, 0.25 mm Cu plus 1 Al filter, 50 cm FSD, 15 minutes to each portal, six séances, with a total time dose of 90 minutes within three weeks ($450 \text{ r measured in air } \lambda_{\text{eff}} 0.220 \text{ Å}$) repeated in one month. Later the following factors were employed: 185 K V, 5 ma, 0.5 mm Cu plus 1 Al filter, 50 cm FSD, $\lambda_{\text{eff}} 0.180 \text{ Å}$, 160 r per portal every other day for four sittings, 640 r total per field. For some time past the factors have been 200 K V, 8 ma, 0.5 mm Cu plus 1 mm Al filter,

50 cm FSD, λ_{eff} 0.175 Å, 168 r per field per sitting

Contrary to the experience of Czerny and Heinemann I have not found the skin of patients with syringomyelia more sensitive to x-rays than the skin of others coming for treatment

Only one patient in the series complained of so-called roentgen sickness, and she was in the group receiving intensive treatment. The symptomatic relief, however, was so satisfying to the patient that she insisted on continuing treatments although it was necessary to hospitalize her.

Both patient and roentgen therapist may need encouragement to continue x-irradiation. Six in this series believed that their symptoms, especially pain, were aggravated by treatment at the start. Often the neurologist will submit an adverse report in spite of apparent objective and subjective improvement in the patient, because periosteal reflexes and muscle coordination have not returned to normal and certain parathesias, though modified, remain. Neither situation should deter one or the other from going forward with the treatments as planned.

Occasionally disturbance of the temperature sense will continue for some time after the restitution of other kinds of cutaneous sensibility. Why the function of the pain-conducting fibers should be restored more quickly under the influence of irradiation than the function of the temperature-conducting fibers is not clear.

It has been our experience—and noted by others—that improvement of cutaneous sensibility generally occurred first in those regions of the skin which corresponded to the marginal segments of the involved part of the spinal cord and in which the pathologic process had developed last. An obvious explanation of this would be that, other things being equal, the part last to be involved might be expected to be more sensitive to x-rays than the segment diseased for a longer time.

Favorable results occurred in our group using medium as well as high voltage x-

rays. Good results have been reported from other clinics with low voltage. This raises the question again of wave length and absorbed radiation. The total dosage in roentgens per case administered in our own clinic in the treatment of this disease since employing high voltage is contrary to all older concepts and is comparable to the protracted high tension low intensity irradiation now being employed by Coutard and his school with such brilliant results. My impression is that our later cases have shown more immediate improvement than the earlier ones because of the employment of this method of irradiation. Irradiation sickness has been the exception and skin damage has not been observed.

One's enthusiasm may be tempered by the knowledge that this disease when not treated may show periods of remission or be quiescent over a considerable length of time. Taylor, Greenfield, and Martin (57) report a case that underwent no change of consequence during a period of twenty-four years but this is the exception and not the rule. Improvement following irradiation occurred in so many cases and so promptly that it is unreasonable to say that it is due to spontaneous remission or the natural history of the disease.

For more than a quarter of a century now no other method of treatment has shown such a high percentage of favorable results, so that irradiation of syringomyelia may conservatively be pronounced the method of choice.

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OSTEITIS TUBERCULOSA MULTIPLEX CYSTICA¹

WITH REPORT OF TWO CASES

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HERE are two types of tuberculosis of the bones. The first and most common is the one occurring in the region of the metaphysis, where there is usually only one bone and joint involved. The dissemination is hematogenous and the predilection for the metaphyseal region according to the work of Lexer is to be found in the peculiar vascular structure in this region in the growing long bones

at any stage of its development, be surrounded by fibrous tissue, and present a fibrous cystic appearance which remains unchanged over a long period.

The second and rarer form of tuberculosis of the bones is that one involving the diaphysis, this form usually being multiple. The dissemination is probably hematogenous. Fibrosis frequently predominates, surrounding the caseations and resulting



Fig 1 Case R. A. Film showing a tuberculous infiltration of the lungs with enlarged mediastinal glands and cystic areas in several of the ribs



Fig 2 Case R. A. Film of skull showing numerous cystic areas in the frontal bone, parietal bones, occipital bone, and in the mandible. These are clear-cut areas of bone destruction which are smoothly outlined and surrounded by a slight degree of sclerosis.

Schulze, working with experimental animals, injected dye in Ringer's solution in the femoral artery which lodged in the end-arteries in the metaphysis with a resulting circumscribed ischemia. He suggests that tubercle bacilli could produce a similar embolus with resulting caseation. The process extends, infiltrating the epiphysis and destroying it, ultimately involving the joint, it may become arrested.

in a cyst which remains comparatively quiescent and unchanged over a rather long period. This type was probably first described by Kreibish, in 1904, which, in appearance, closely corresponded to cases later reported by Jungling, in 1920. Reider, in 1910, published an article on the combination of chronic osteomyelitis with lupus pernio. German dermatologists had long known that the so-called tuberculides of the skin (lupus pernio and Boeck's sarcoid) were not infrequently associated with

¹ Presented before the Philadelphia Roentgen Ray Society Nov. 1, 1934.

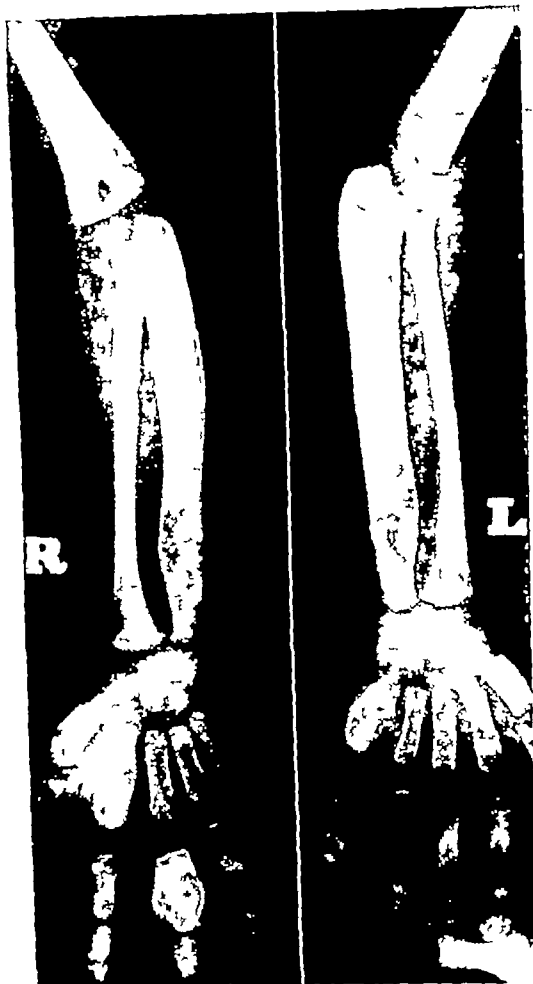


Fig 3 Case R A Film showing a cystic tuberculous osteitis with expansion of the cortex sclerosis and bone destruction in the bones of both forearms and hands

chronic bone changes in the hands and feet Jungling, in 1920, made the most lucid and comprehensive observations of these cystic changes of bone to which he applied the name "osteitis tuberculosa multiplex cystica" In 1924, Fleischner investigated the dermatologic literature and found a great number of cases with bone changes in the hands and feet There is comparatively little in the American literature regarding the bone changes associated with tuberculous lesions of the skin Doub and Menagy, in 1929, reviewed the scanty literature and presented two cases with bone lesions occurring in sarcoid in adults Jüngling, in 1928, re-



Fig 4 Case R A Film showing cystic changes in both femora

viewed the literature and reported 46 cases to which he added nine of his own Practically all of these have involved the phalanges, metacarpals, and metatarsals, but rarely the larger long bones Van Alstyne and Gowen reported a multiple cystic type of tuberculosis occurring in the long bones in an adult Schwenkter, in 1931, reported on a multiple cystic tuberculosis of the bone in an infant one year of age

We are reporting two cases because of the paucity of the cases in the literature There is only one case occurring in an infant recorded in American literature One of our cases is of especial interest because of the widespread distribution of the lesions The second case had only two areas involved

CLINICAL ASPECTS

Cystic tuberculosis of bones in children is due to a dissemination of the tubercle bacilli through the blood stream, probably from a broken-down, caseous lymph node in the chest This must have occurred

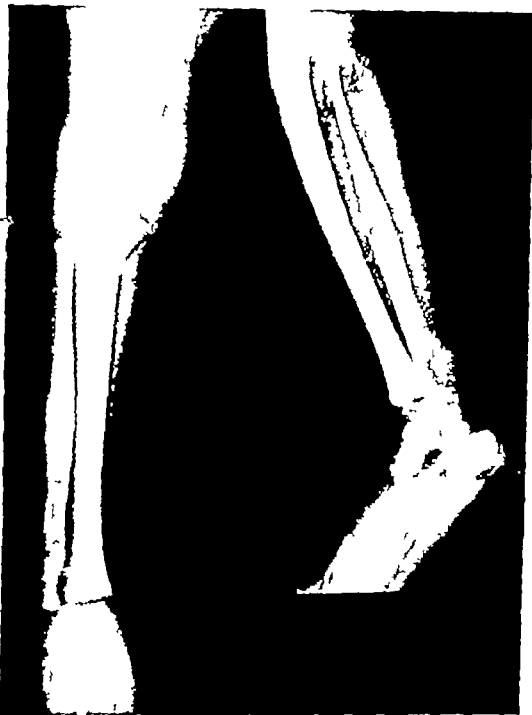


Fig 5 Case R. A Anteroposterior and lateral films of the right lower leg and ankle showing extensive cystic areas in the tibia and fibula surrounded by osteitis, with a defect in the lower end of the fibula at the site from which a biopsy was taken

a considerable time before the cystic condition became manifest in the bones, and the patient may therefore have recovered from the acute clinical symptoms and be a well-nourished, well-developed child

There may or may not be swelling over the involved bones and since these cystic areas are apparently painless, the condition is doubtless more common than the few reported cases in the literature would indicate. This is illustrated by one of our cases, admitted to another hospital two years after being examined by us. The patient died of bronchopneumonia and an autopsy was performed upon the abdomen and chest without the recognition by the clinician or pathologist of any tumefactions over the bones. Cystic tuberculosis of bone is probably present but unrecognized in many cases of infantile tuberculosis. It is not diagnosed because there is no pain, tenderness, nor evidence of inflammation. Routine fluoroscopy of the long bones in infants, examined roentgenologi-

cally with a question of tuberculosis in the chest, may lead to a more frequent recognition of the condition

The cystic areas sometimes break through the cortex, form abscesses which rupture through the overlying skin, and sinuses develop. This occurred in the angle of the jaw and the first metacarpal in one of our cases, and over the right ulna in another case, with complete healing of the sinuses eventually in both. The cystic condition of the bones in the one case went on to complete healing, while they were regressing in the other when the child died from bronchopneumonia, two years after having been first seen by us.

Fever is not necessarily present with cystic tuberculosis of the bones. It may occur as a result of secondary infection through a draining sinus, or as a result of the primary tuberculous process in the chest.

The blood picture is not characteristic; there is an associated secondary anemia. A leukopenia and slight lymphocytosis may be found. The blood chemistry is not changed, this being an important diagnostic aid in differentiating cystic tuberculosis from osteitis fibrosa cystica.

Diagnosis should be made from the roentgenograms, in which the appearance is quite characteristic. Confusion may arise in differentiating this condition from osteitis fibrosa cystica, chondromatosis, syphilis, etc. The blood chemistry is changed in osteitis fibrosa cystica. The blood calcium and phosphorus are within the normal limits in cystic tuberculosis. Denks recently discussed the differential features of cystic tuberculosis and enchondromas.

A strongly positive tuberculin reaction is an important diagnostic evidence. Negative serologic tests are valuable in making a diagnosis of syphilis improbable, although cystic tuberculosis of bone and syphilis may occur coincidentally.

Clinical or roentgen evidence of an infantile tuberculous process in the chest, particularly involvement of the bronchial glands, is found in the following cases:

Case 1 R A , a colored boy, aged 17 months, was first examined in February, 1932. The chief complaint was "lumps" on fingers, wrist, ankle, and foot, which had been present since the child was six months old. The skin over one of these had ulcerated four months previous to examination. The child's birth and development had been normal, and his general health had always been good. He had had no acute infections except for two mild colds. The family history was negative. Careful questioning revealed the fact that a boarder with active tuberculosis had lived in the same house with the family but had been removed to the hospital just before the baby was born. No attempt to clean the house had been made subsequent to his removal.

On physical examination, the child was found to be poorly nourished, weighing only eighteen and one-half pounds. His tonsils were large and infected. He had moderate rickets. The rest of his physical examination was essentially negative except for the bone deformities, only eight of these were noted before the roentgen examination. Two metacarpal and two metatarsal bones were involved as well as three phalanges. These swellings were hard, painless, and pyriform in shape. Two hard, smooth prominences about one inch in diameter were palpated on the forehead. A bony swelling on the lower end of the left ulna was partly obscured by an overlying, granulating ulcer of the skin. Another was found in the region of the external malleolus.

The blood count revealed a moderately severe anemia. The urine examinations were negative. The blood Ca was 7 mg per 100 c c serum. The Wassermann test was negative. Intracutaneous tuberculin done on admission were negative up to 1 mg; these were not repeated later.

During the child's four months' stay in the hospital, he had a very severe and prolonged attack of bilateral, suppurative otitis media, bronchopneumonia, and marked cervical adenitis. His temperature was elevated at various times to 103



Fig 6 Case R A Film showing tuberculous cystic osteitis of metatarsals and phalanges of the feet

and 104, but usually fluctuated between 98 and 100 degrees. Two months after his admission he developed styes and a phlyctenular conjunctivitis. His weight was stationary the first two months of his hospitalization but increased five pounds the last two months. His general condition improved remarkably during the last six weeks in the hospital, as did also his ears and chest. Little improvement was noted in the bony prominences. He was discharged June 11, 1932.

Five weeks later, the swellings in the hands were much smaller and the bony deformities of the forehead had disappeared. Scar tissue was present at the site of the former ulceration, and also at the site of the operative area where a biopsy had been done on February 16, on a fragment of the fibula. A microscopic description of biopsy material follows. Sections show fragments of bone and granulation tissue. Typical tubercles are present in some places in the granulation tissue.



Fig 7 Case E F Film of chest showing tuberculous infiltration in right lung with enlarged mediastinal glands and pleural effusion

There are also areas of necrosis (caseation). In some places the bone is eroded and the bone corpuscles stain poorly. Near the granulation tissue, the bone shows very active growth, the marrow spaces being lined by large osteoblasts, sometimes several layers deep. No typical bone marrow is seen, however. Pathologic diagnosis: tuberculosis of the bone with a rather unusual amount of bone proliferation.

Case 2 E F, aged 2 years, was first examined on Feb 22, 1930. The chief complaints were a running ear of two months' duration, and a swelling on the left hand for one month. He had had a cold and cough for three weeks. History revealed that he had always had a tendency to catch cold. He had a severe case of pertussis and pneumonia at one and one-half years of age. Family history was negative for syphilis and tuberculosis. No history of exposure to tuberculosis was elicited.

On examination the child was found to be suffering from suppurative otitis media of the left ear, and very marked left-sided cervical adenitis. He had signs of consolidation and fluid in his right chest. His

highest temperature was 101 degrees. He coughed frequently and often with an inspiratory crowing sound.

Two tense, firm, painless swellings were present in the dorsum of the left hand and one on the thumb, also there was a hard bony enlargement at the angle of the left jaw. The blood showed a moderately severe anemia. Blood calcium was 8 mg per 100 c.c. of serum. Urines were negative. The blood Wassermann was negative. Intracutaneous tuberculin test was positive in 24 and 48 hours with a 0.1 mg dose.

The child remained in the hospital four weeks, during which time his temperature usually ranged between 99 and 100, reaching 101 on only four occasions. After the first two weeks, he gained fairly well in weight and his general condition definitely improved. His ear cleared up considerably but not entirely. There was an improvement in the physical signs in his chest. Cervical adenitis persisted. There was little improvement in the bony swellings. He was discharged on March 18, 1930, with the diagnosis of tuberculous bronchopneumonia, dactylitis, tuberculous cyst in the angle of jaw, and chronic otitis media.

ROENTGENOLOGIC APPEARANCE

Jüngling says the roentgenogram is characteristic and is the chief means of distinguishing tuberculids of the bone. There is a rarefaction originating in the marrow which may be single or multiple, presenting a spotty appearance if multiple. The process may spread diffusely through the entire involved bone, or may appear as a circumscribed rarefaction in certain sites of predilection, particularly in the heads of phalanges where the condition is nearly always multiplied. There have been two types described by Jüngling, first, the diffuse type, and second, the circumscribed type.

In the diffuse type, the cortex and medulla cannot be differentiated. The entire bone is characterized by a web-like structure of increased density. This type

is the initial stage and represents the more acute and florid process. He described the large spotted type, and the small

Case R A On Feb 3, 1932, films and fluoroscopy of the chest showed an extensive mottled filtration about both

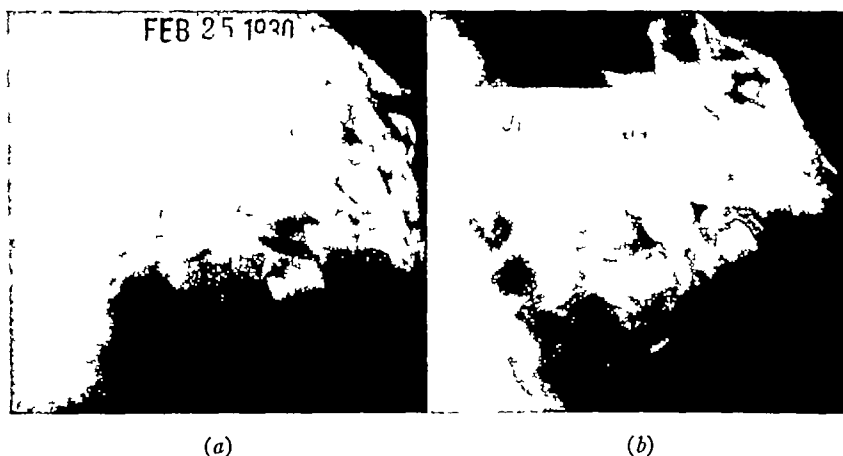


Fig 8 Case E F (a) Film of mandible showing a cystic area (b) Same case six and one half years later showing slight defect at the lower margin of the jaw but no definite evidence of the former cyst

spotted type of diffuse involvement, the latter being a manifestation of a more slow, torpid course. The bone is usually larger in diameter. In the large diffuse type, there may be destruction of the entire phalanx, as in the case reported by Fleischner, or there may be destruction to the extent that spontaneous fractures occur. In a case in which there is no secondary infection, there is only moderate sclerosis of bone. The bone atrophy which is seen in the more common tuberculous process of bone is less noticeable in these cases.

The circumscribed type is characterized by a round, rather smoothly outlined, punched-out area of decreased density. The cortex is a paper-thin shell which may or may not be penetrated. There may be a faint ring of sclerosis about these cystic areas, or there may simply be a clear-cut margin, with no alteration in density of the surrounding bone. The cortex is shown to be either expanded or destroyed. This circumscribed type represents a healing stage, and these cysts may proceed without appreciable change for a long period of time, may regress with little subsequent deformity of the bone, or may progress to the formation of abscesses with sinus formation.

hili, with an increase in the transverse diameter of the mediastinal shadows suggesting the presence of an infantile type of tuberculosis. There was a small, sharply circumscribed area of decreased density in the sixth rib on the left side posteriorly. There was a symmetrically placed area of decreased density in the same rib on the right side.

Roentgenograms of the skull showed numerous homogeneous areas of decreased density involving the frontal, occipital, and both parietal bones. These ranged in diameter from 5 to 20 millimeters. There was little evidence of normal bony structure or trabeculation in these areas. There was a rather sharply outlined margin, with slight increase in density, suggesting bone reaction about some of these but not about all of them. This is apparently the circumscribed type, described by Jungling, which represents a more or less stationary phase of the disease. There was no breaking down during the two years preceding the fatal termination of the patient's life from another cause.

There were two areas of decreased density in the right side of the mandible, near the angle, each measuring about one centimeter in diameter. There was slight

crease in density at the periphery of these areas. These broke through the cortex, producing an abscess in the cervical region

which is approximately three centimeters in length and almost the entire diameter of the bone. This has a loculated appearance

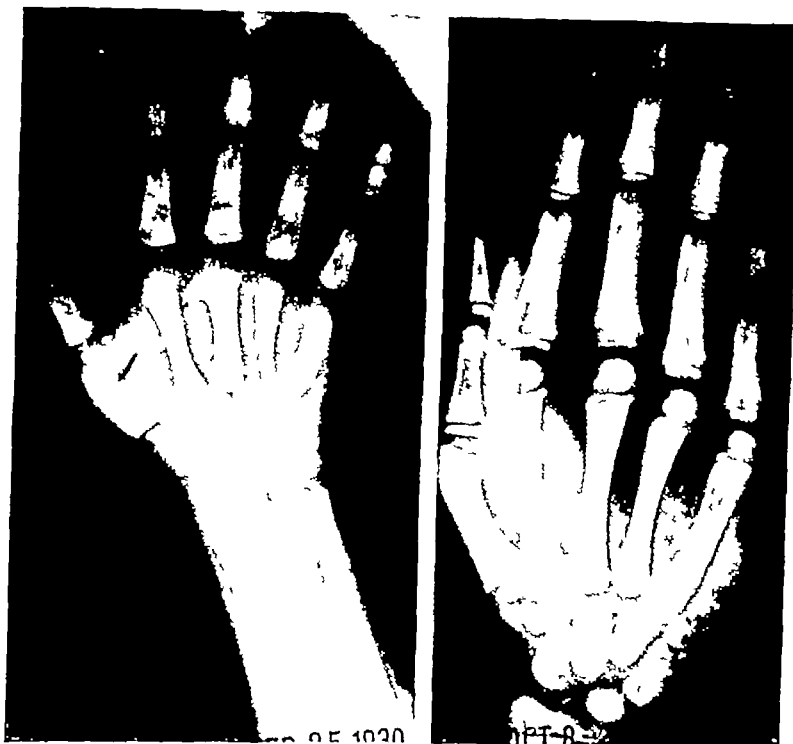


Fig 9 Case E F (Left) Film showing dactylitis with cystic area (Right) Same patient four and one-half years later with the fistula healed and osseous process healed or quiescent.

with a resulting sinus which eventually healed.

Films of the arm show two rather large areas of decreased density in the right ulna which measure approximately three centimeters in length and are the entire width of the bone, being covered by a rather thin shell of cortex. There is a slight periosteal reaction of overlying bone with increased density at the periphery of these cysts, and definite expansion of the cortex. These are evidently the circumscribed cysts of Jungling. There is a small area of increased density in the upper third of the diaphysis of the right ulna, with slight expansion of the cortex and slight evidence of periosteal reaction. This probably represents a healing or regressing cyst.

There is an irregular area of decreased density at the lower end of the left ulna

ance. The cortex is expanded and there is a slight increase in density of the overlying bone. There is a similar cystic area at the proximal end of the left ulna.

In the intervening bone, the presence of mottled areas of increased and decreased density suggest the appearance of the diffuse type of Jungling. There is a small area of decreased density at the lower end of the left ulna.

Films of the right hand show a diffuse involvement of the first metacarpal, the second metacarpal, and the proximal phalanx of the middle finger. There is expansion and breaking through of the cortex. There is a similar appearance of the first and fifth metacarpal of the left hand, and the middle phalanx of the ring finger of the left hand. Figure 4 illustrates the hands of the same case two months later.

and comparison with Figure 3 shows these areas of decreased density to be assuming a circumscribed nature, representing the healing or quiescent stage as described by Jungling. This comparison of a change from the diffuse into the circumscribed type is particularly well seen in the proximal phalanx of the ring finger of the right hand, where the later films show the cortex to be more smooth and dense, and the cystic area to be more homogeneous with absence of trabeculations.

There are small areas of increased density in the lower ends of both femora, measuring approximately one centimeter in diameter, entirely within the diaphysis. These are apparently the circumscribed type of cysts.

Films of the left lower leg show no demonstrable evidence of involvement. Anteroposterior and lateral films of the right lower leg show clear areas of decreased density in the middle third of the tibia—apparently a circumscribed type. There is only slight expansion of the cortex and slight periosteal reaction with a moderate increase in density surrounding this cyst. There is a more irregular, less circumscribed or more diffuse type of decreased density involving the upper third of the tibia to within about one centimeter of the end of the diaphysis. There are two areas of decreased density in the fibula, one in the middle third, and one at the lower end of the diaphysis, about two and one-half centimeters in length and involving almost the entire diameter of the bone. The cortex is thin and in the lower one is completely destroyed in the posterolateral aspect where there has been a rupture of the cortex with abscess formation, with a draining sinus to the lateral aspect of the ankle. These films of the right lower leg exhibit the following different stages to which cystic tuberculosis may progress: the diffuse type, the sharply circumscribed, more or less quiescent type, and rupture through the cortex with sinus formation. Films of the feet show clear areas of decreased density involving the first and third metatarsals and proximal phalanges

of the great toe of the left foot, and first metatarsal of the right foot. These are of the diffuse type, probably assuming the quiescent or circumscribed stage.

Case E F. Films of the chest and fluoroscopy show an extensive mottled increase in density about both hili, being more marked on the right side. There is an increase in the transverse diameter of the mediastinal structures suggesting the presence of large bronchial or mediastinal glands. Also, there is a definite increase in density about the periphery, suggesting the presence of thickened pleura with a local collection of fluid between the middle and upper lobes. A re-examination of the chest 56 months later shows an increase in density about the hili with calcification, a residuum of his former infantile type of tuberculosis, and probably of little significance at the time of the latter examination. This corresponds with his improvement clinically. At the time of the latter examination, he was a strong, well nourished, colored child, six and one-half years of age.

A film of the lower jaw shows an area of decreased density measuring approximately 1×1.5 cm near the angle, with expansion and thinning of the cortex presenting the appearance of a blister near the angle of the mandible. A film taken of this region 56 months later shows an irregularity and a depression of the cortex at the site of the former cystic area, but there is no longer any evidence of decreased density in this region.

In the interim between the two examinations there was a breaking through of the cortex with abscess formation in the cervical region and formation of a draining sinus which ultimately healed, and at the present time is apparent only as a small scar. There are no calcified tuberculous nodes in the neck.

Roentgenograms of the hand show a definite increase in density of the first metatarsal, with numerous small areas of decreased density, coarsening of the bone markings, and widening of the diameter with a rather sharply punched-out beginning area of decreased density at the

center of the bone. A film taken 56 months later shows little appreciable evidence of the former disease. In the interim, there was a rupture through the cortex with abscess and sinus formation which has healed and at the present time is apparent only as a small scar on the dorsal surface of the hand.

SUMMARY

There are reported two cases of cystic tuberculosis of the bone. The diagnosis in one of these was made by biopsy. The diagnosis in the other case was made clinically and roentgenologically but was not confirmed. The roentgenologic findings are quite diagnostic. These cases are reported because there is only one other case of cystic tuberculosis of bone occurring in an infant, that by Schwenkter, reported in the American literature. Since there

is not always a conspicuous tumefaction over these cystic areas, it is suggested that the presence of this condition is often unrecognized and is probably far more common than the number of cases in the literature would indicate.

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VOLUME-INCREASE OF BACTERIA FROM X-RAY IRRADIATION

By THOMAS J DIETZ

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EXPOSURE to x-rays is by nature lethal to living cells, but it sometimes happens that small dosages bring about enhanced growth, or swelling of cell cytoplasm. It may be said that in general small dosages of x-rays cause stimulation of various chemical reactions in biological colloidal systems, while larger dosages cause inhibition and destruction.

medium through an altered cell membrane. It is suggested that intracellular changes produce new electrolytes by the decomposition of salts, proteins, and fats, and that water is taken in by simple osmosis (2). Such an interpretation necessarily suggests an alteration in cell constituents, and thus an abnormal condition. The mechanics of cytoplasmic swelling

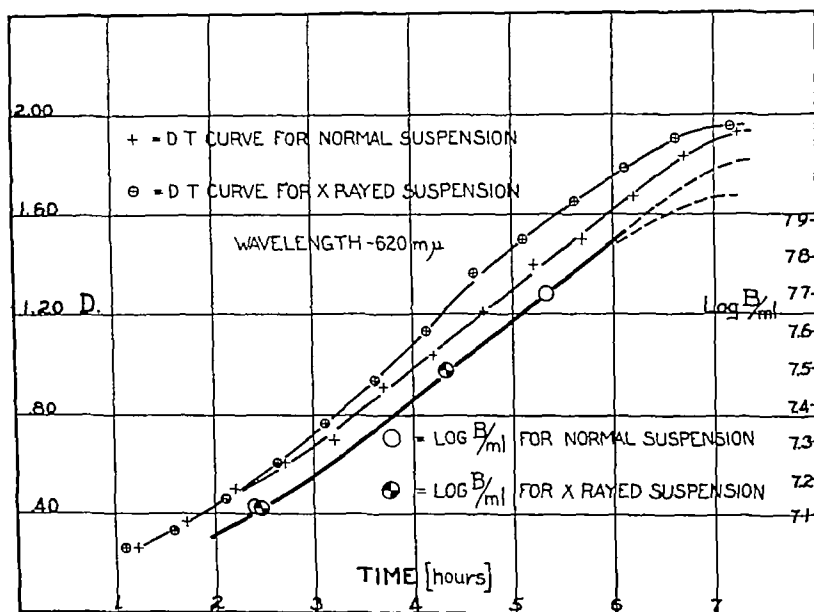


Fig 1 Optical density-time curves and bacterial count-time curves plotted from observations on the irradiated and control suspensions as listed in Table I. The irradiated suspension was first exposed to x-rays in the lag phase.

However, the opinion has been expressed that the present-day evidence is inclined toward the conclusion that radiations do not directly stimulate the normal activities of the cell, and that their primary effect is always an injury from which the cell may recover perfectly (1). The quality of x-rays and the period of exposure that bring about cell swelling are worthy of investigation because of the subtle cell changes supposedly involved. A simple explanation of the phenomenon involves an increased capacity of the irradiated cells for the absorption of water from the

of bacteria and of enhanced bacterial growth, as caused by exposure to x-rays, is quite obscure, and facts concerning it are of fundamental importance. The writer has undertaken the study of these effects, and the work herein described was a definite preliminary part of the investigation. Experiment showed that under the proper conditions volume-increase occurred when bacteria were exposed to x-rays. Whether this volume-increase was enhanced growth, cytoplasmic swelling, or a combination of both, is a question to be considered. This paper is concerned primarily with the

observed increase in volume *per bacterium* and the resulting deductions The investigation was carried out for *Bacillus coli* constant-deviation spectrometer, and specimen tubes for the examination of liquids The analyzer circle of the pho-

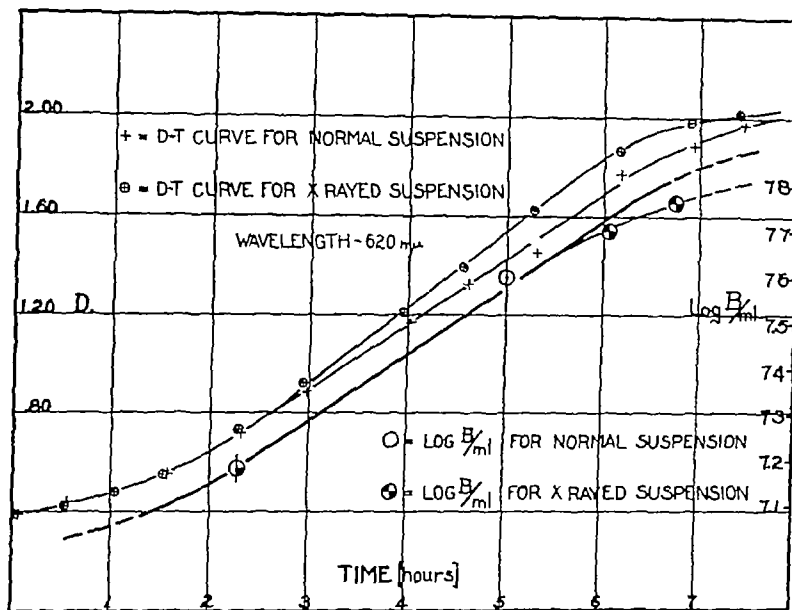


Fig 2 Optical density-time curves and bacterial count-time curves plotted from observations on the irradiated and control suspensions as listed in Table II The irradiated suspension was exposed to x-rays entirely in the logarithmic growth phase

alone, but the effect is not believed to be unique for that organism The problem was considered from the point of growth-rates of suspensions of *B coli*, i.e., turbidity changes of the growing suspensions This method of approach was more feasible than the study of growth on a solid medium, although it was not certain that bacterial swelling under irradiation was conditioned by a liquid medium

APPARATUS AND METHODS

The rate of bacterial growth was recorded by means of measurements upon the light transmission of a suspension of *B coli* as related to the transmission of sterile broth A spectrophotometer was used, because intensity values of the transmitted light for different parts of the spectrum seemed to open paths to additional facts concerning growth analysis The spectrophotometer consisted of a source of light, an improved Martens-type photometer, a

tometer was graduated so that one quadrant read in optical densities, a second in transmission per cent, and a third and fourth in degrees Recorded values of suspension growth were taken in terms of optical density rather than actual percentage of transmission Optical density was a function increasing with bacterial growth, thus giving a curve with a positive slope when optical density was plotted against time

Optical density is herein defined as

$$D = \log \frac{I_0}{I}, \quad (1)$$

where D = optical density reading,
 I_0 = intensity of light after traversing control tube containing sterile broth,
 I = intensity of light after traversing tube containing growing bacterial suspension

Preliminary experiments showed that the optical density was related to the

actual bacterial total count according to the relations expressed below. Analysis was confined to the phase of logarithmic growth with the straight line relation,

$$\log B = a_1 t + b_1, \quad (2)$$

where B = change in number of bacteria during time interval, t ,

t = time interval under consideration,

a_1 and b_1 are constants depending upon suspension, temperature, PH, etc

Likewise in the corresponding region of the optical density-time curve the relation was

$$\log \frac{I_0}{I} = a_2 t + b_2 \quad (3)$$

The bacterial count-time curve and the optical density-time curve proved to be substantially similar so that for any one suspension

$$a_1 = ka_2 \quad (4)$$

Then

$$\log B - k \log \frac{I_0}{I} = (a_1 - ka_2)t + b_1 - kb_2,$$

$$\text{or} \quad \ln B - \ln \left[\frac{I_0}{I} \right]^k = 2.303 b,$$

$$\text{from which} \quad \frac{B}{\left[\frac{I_0}{I} \right]^k} = \text{Constant} \quad (5)$$

Thus it was possible to study the growth of *B. coli* under x-ray irradiation by means of optical density observations with a fair degree of accuracy. No mention was made of specimen tube length because it affected only the constants of the relation. The specimen tubes were 10 cm long and 1.5 cm in diameter, and were each supplied with an opening through which a sample of the suspension could be withdrawn at any time for cell count.

The x-ray tube used in the investigation was an ordinary self-rectifying tungsten target tube operating at approximately 75 kilovolts peak voltage, as measured with a sphere gap, and between 1.2 and 1.6 milliamperes tube current. Tube current was varied for different experiments, but

TABLE I —SPECTROPHOTOMETRIC READINGS AT WAVE LENGTH 620 M μ

Control Suspension Time	D	X-rayed Suspension Time	D
5 min	0.26	0 min	0.26
35	0.37	30	0.33
66	0.50	60	0.46
96	0.61	91	0.61
125	0.70	120	0.76
155	0.91	150	0.93
185	1.04	181	1.13
215	1.21	210	1.37
245	1.40	240	1.50
275	1.50	270	1.65
305	1.67	300	1.78
335	1.83	330	1.90

Periods of Irradiation

- 1 40th minute to 60th minute
- 2 65th minute to 90th minute
- 3 95th minute to 120th minute
- 4 125th minute to 150th minute
- 5 155th minute to 180th minute

Total exposure	120 min
Tube current	1.0 ma
Target distance	9 cm
Temperature	24° C

Total Cell Count

Control Suspension Time	B/ml	X-rayed Suspension Time	B/ml
85th min	3.65×10^7	87th min	3.64×10^7
260th min	7.10×10^7	200th min	5.57×10^7

(The data in this table are plotted in Figure 1.)

The total volume per average bacterium was calculated from photomicrographs by the formula, length \times breadth $\times \pi/4$.

Total Volume per Average Normal Bacterium	0.75 cubic micra
Total Volume per Average Irradiated Bacterium	2.00 cubic micra

was held constant throughout each experiment. The target was placed at a distance of 9 cm from the midpoint of the axis of revolution of the specimen tube. Proper cooling of the specimen tube under exposure was necessary so that the temperature of the contained suspension remained equal to that of the control suspension.

The suspension under observation was prepared by inoculating nutrient broth with *B. coli* from a 24-hour culture on nutrient agar; the inoculation was sufficient to give an initial concentration of approximately 1×10^7 B/ml. The suspension was then placed in each of two specimen tubes for spectrophotometric study. It was found most convenient and, in fact, quite necessary to have the suspensions grow at temperatures ranging

between 20° C and 25° C. As soon as the suspensions began to show active growth one of the specimen tubes was exposed to x-rays, the other was used as a

RESULTS

Several experiments are recorded here with tables and graphs to illustrate the

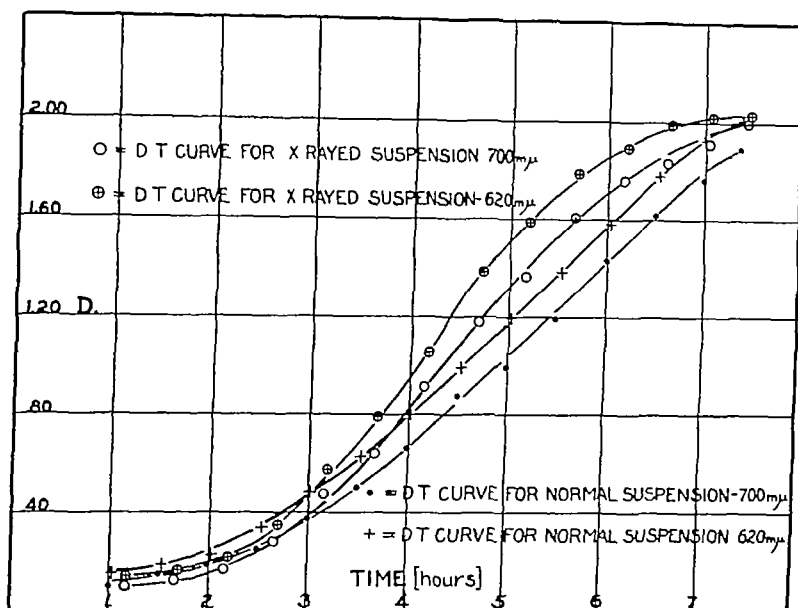


Fig 3 Optical density time curves plotted for two different wave lengths in the red from observations on the irradiated and control suspensions as listed in Table III. X ray exposure of the irradiated suspension was in the lag phase of growth.

control. The irradiated specimen tube was given a dose consisting of fractional exposures of from 20 to 25 minutes each, with 10-minute intervals between exposures for observation, the total dose varied between 90 and 120 minutes for different experiments. No attempt of dosage ionization measurement was made because it is believed that this bacterial swelling is not sufficiently critical to necessitate accurate duplication of biological dosage. Spectrophotometric readings were taken at half-hour intervals for several wave lengths from 600 $m\mu$ to 700 $m\mu$, inclusive. Regular variations occurred in the optical density-time curves plotted for different wave lengths, and were caused by the relative spectral energy distribution of the source. An optical density-time curve, which held true regardless of wave length, could be calculated by correcting for relative spectral energy distribution of the source and for visibility of radiant energy (3).

points of interest. Examination of the optical density-time curves for the several experiments revealed the optical density of the irradiated suspension to be increasing at a faster rate than that of the control suspension. Actual cell count indicated that, at any time during the major portion of the phase of logarithmic growth, the total cell number was the same for both suspensions. Mathematical analysis was confined to Table I, because that experiment showed most clearly the relation between the normal suspension and the irradiated suspension. The morphological relation between the normal bacteria and the irradiated bacteria is clearly indicated in Figures 4, 5, and 6. Figure 4 is a sample of the normal suspension taken during the second hour of logarithmic growth, Figure 5 is a sample of the irradiated suspension also taken during the second hour of logarithmic growth. Figure 6 is a sample of the irradiated suspension taken at the beginning of the maximum

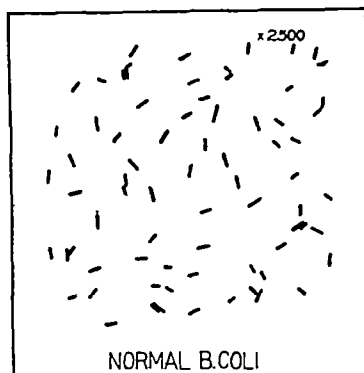


Fig 4. Tracing from a photomicrograph of a stained preparation of normal *B. coli*. The prepared sample was taken from the suspension during the second hour of logarithmic growth

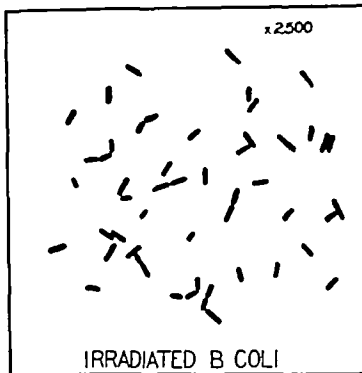


Fig 5. Tracing from a photomicrograph of a stained preparation of irradiated *B. coli*. The prepared sample was taken from the suspension during the second hour of logarithmic growth

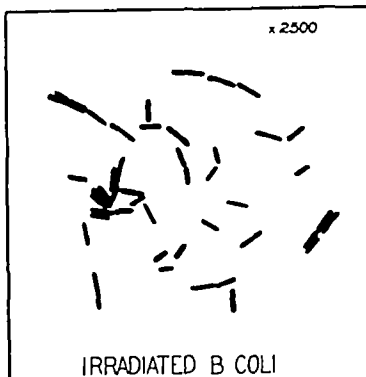


Fig 6. Tracing from a photomicrograph of a stained preparation of irradiated *B. coli*. The prepared sample was taken from the suspension during the phase of negative acceleration directly preceding maximum growth

rest phase of growth, inhibition of the ability of fission was noticeable

DISCUSSION

The increase in volume of irradiated bacteria over normal bacteria was of considerable importance since the x-rays had caused no apparent inhibition of fission. For this reason it seemed permissible to consider bacterial volume-increase as a major effect. The writer did not attempt to explain the phenomenon except so far as the actual physical measurements permitted. The empirical formulæ developed were deemed applicable only under the stated conditions. Naturally the experimental evidence cited here only allows the formulæ to be considered as food for discussion.

In accordance with the theoretical procedure, the effect, the swelling of irradiated bacteria, was built upon two distinct considerations, namely, the uninhibited ability of fission during the major portion of the phase of logarithmic growth, and the observed increase in volume of the irradiated bacteria. It was obviously necessary to avoid any inhibition of the property of fission if the mathematical analysis were to be considered of value. Inhibition was noticeable as the growing irradiated suspension approached the resting phase, but it was probably a secondary reaction to the x-rays and was not of

TABLE II —SPECTROPHOTOMETRIC READINGS AT WAVE LENGTH 620 μ

Control Suspension		X-rayed Suspension	
Time	D	Time	D
4 min	0.39	2 min	0.39
34	0.44	32	0.43
64	0.48	63	0.48
94	0.55	92	0.55
139	0.72	137	0.73
179	0.89	176	0.92
241	1.17	237	1.21
276	1.33	273	1.39
318	1.45	316	1.62
371	1.77	369	1.86
418	1.88	416	1.98
448	1.97	445	2.01

Periods of Irradiation

- 150th minute to 170th minute
- 182nd minute to 202nd minute
- 211th minute to 231st minute
- 245th minute to 270th minute
- 280th minute to 307th minute
- 344th minute to 365th minute

Total exposure	133 min
Tube current	1.6 ma
Target distance	9 cm
Temperature	23° C

Total Cell Count

Control Suspension		X-rayed Suspension	
Time	B/ml	Time	B/ml
138th min.	1.53×10^7	138th min	1.53×10^7
300th min	4.00×10^7	363rd min	5.05×10^7
		405th min.	5.78×10^7

(The data of Table II are plotted in Figure 2)

serious consequence. The marked effect of irradiation, the volume-increase of the irradiated bacteria, as measured under the microscope, was much greater than that indicated by the increase in optical density. This observation led to the temporary deduction that the bacteria had absorbed

water from the medium as a result of irradiation, optical density measurements apparently did not give evidence of absorbed water. Contrary to supposition, no early inhibition of cell activity was induced by the water absorbed, and the increase in volume *per bacterium* persisted until the irradiated suspension entered the negative acceleration phase.

If the average cell volume and the absorption coefficient per average bacterium are assumed to be constant in the phase of logarithmic growth, it is possible to write Equation (5) as

$$\text{Log} \frac{I_0}{I} = k' \text{Log} [B\bar{v}a] + C \quad (6)$$

where

\bar{v} = average effective cell volume,
 a = number proportional to absorption coefficient

The meaning of Equation (6) is decidedly limited, it cannot be said that either \bar{v} or a remain constant over an extended period of time, *i.e.*, three hours or more. However, serious error is avoided when Equation (6) is applied to the same limited region of two similar growth curves, in the present case a curve of a normal suspension is compared with that of an irradiated suspension. The number, a , proportional to the absorption coefficient, is considered constant for both normal and irradiated bacteria because a was directly related to the constitution of cell protoplasm, any change in the absorption coefficient was interpreted as an abnormality. In Equation (6) as evaluated for the normal suspension from Table I, a is chosen so that the product, $\bar{v}a$, is equal to unity. The effective volume and the measured volume are considered equal for the normal bacterium. The only change made in Equation (6) to calculate \bar{v} for the irradiated bacterium is the substitution of the value of $\log I_0/I$ for that suspension, $\log B$ remains unchanged as well as all of the constants.

The value of \bar{v} for the average normal bacterium was found to be 0.75 cubic micra by micrometer measurement, while the

calculated value of \bar{v} for the average irradiated bacterium was 0.85 cubic micra. This value of \bar{v} for the average irradiated bacterium could not be the total volume since that was previously measured to be 2.00 cubic micra. The calculated volume per average irradiated bacterium, *i.e.*, 0.85 cubic micra, was not necessarily the total volume but only that part with an absorption coefficient such that the product, $\bar{v}a$ equaled unity. In other words, any increase in cell dimensions caused by water absorption did not effect a corresponding increase in v .

This concept of \bar{v} agrees with the development from the rate of production of metabolic substances by an actively growing suspension of bacteria. The equation for the relation between \bar{v} and the rate of production of metabolic substances may be

$$\frac{dM}{dt} = KB\bar{v}, \quad (7)$$

during the phase of logarithmic growth, or since $B = C'e^{k't}$,

$$m = \int_{t_0}^t K' \bar{v} e^{k't} dt$$

Thus

$$M = K'' \bar{v} e^{k'(t-t_0)},$$

where

M = quantity of metabolic substances produced between time t_0 and t ,

B = change in number of bacteria per ml between time t_0 and t ,

\bar{v} = effective volume per average bacterium,

K'' and k' are constants

From this it can easily be seen that

(a) $\text{Log } M = k_1 t_n + K_1 \bar{v}_n$ for the normal suspension, and

(b) $\text{Log } M = k_1 t_x + K_1 \bar{v}_x$ for the irradiated suspension. For equal values of M , subtracting (b) from (a),

$$t_n - t_x = K'_1 (\bar{v}_x - \bar{v}_n) \quad (8)$$

The condition is imposed that time be counted from the point where the optical

density-time curve for the irradiated suspension departs from that of the normal suspension, in theory $t = 0$ at the time when the suspension to be irradiated is first exposed to the λ -rays

Since M , the quantity of metabolic substances produced, and B , the bacterial count, were both functions of D , the optical density of the suspension, it was possible to apply the relation (8) to the optical density-time curves with acceptable results. The relation (8) was considered applicable as long as the actual bacterial counts of the normal and irradiated suspensions were equal. With \bar{v} for the average normal bacterium equal to 0.75 cubic micra, the \bar{v} calculated from Equation (8) for the average irradiated bacterium was 0.86 cubic micra.

Although the optical density of the growing irradiated suspension increased more rapidly than that of the normal suspension in the logarithmic growth phase, it was found that the maximum optical densities of the two were identical. Thus maximum optical density seemed to be a function of the volume of cell material rather than cell numbers. This was not strange since the irradiated bacteria were apparently undergoing normal development. Also the irradiated suspension entered the phase of negative acceleration sooner than did the normal suspension, an observation which was plausible as long as bacterial numbers remained equal in the two suspensions. This increase in average cell volume of the irradiated bacteria over the normal bacteria could only be interpreted as an increase in active protoplasmic volume, a volume-increase which did not bear relation to that produced by water absorption. Butterfield (4), in observations on the resting phase of bacteria growing in a liquid medium, found that a correlation might exist between the limiting numbers of bacteria which develop in a medium and the size of the individual cells. His work also indicated the existence of a definite relationship between the concentration of the food supply and the limiting numbers of bacteria.

TABLE III—SPECTROPHOTOMETRIC READINGS AT WAVE LENGTHS 620 $m\mu$ AND 700 $m\mu$

Control Suspension Time	D		X-rayed Suspension Time	D	
	620 $m\mu$	700 $m\mu$		620 $m\mu$	700 $m\mu$
0 min	0 15	0 10	10 min	0 14	0 10
30	0 19	0 15	40	0 16	0 13
60	0 23	0 19	70	0 22	0 17
90	0 34	0 25	100	0 35	0 28
120	0 48	0 37	131	0 57	0 47
150	0 63	0 50	160	0 79	0 64
180	0 80	0 66	190	1 05	0 91
210	0 99	0 87	222	1 38	1 18
240	1 19	0 99	250	1 58	1 36
270	1 38	1 19	280	1 78	1 65
300	1 57	1 43	311	1 88	1 75
330	1 77	1 61	337	1 98	1 84
360	1 92	1 75	363	2 01	1 90
385	2 00	1 88	388	2 02	2 00

Periods of Irradiation

- 1 72nd minute to 99th minute
- 2 103rd minute to 127th minute
- 3 135th minute to 157th minute
- 4 163rd minute to 188th minute
- 5 193rd minute to 218th minute

Total exposure	123 min
Tube current	1.2 ma
Target distance	9 cm
Temperature	26° C

(The data of Table III are plotted in Figure 3.)

Examination of the data of a number of experiments indicated enhancement of growth and stimulation of metabolic exchanges in the irradiated suspension. The increased activity of the irradiated suspension seemed to be of such a nature as could be produced by a slight increase in temperature suggestive of energy absorption as based upon the Point-Heat Hypothesis. This hypothesis as advanced by Dessauer (5) explained the action of x-rays as the change of absorbed energy into molecular movement. Strangeways and Fell (6), and later Packard (7), pointed out that there was a correlation between the survival of irradiated biologic material and the rate of division after exposure as a function of temperature. A greater percentage of irradiated material survived under reduced metabolism at lower temperatures. In carrying out the experiments outlined in this paper the writer attempted to avoid secondary effects of the λ -rays by reducing the temperature for bacterial growth to 25° C.

SUMMARY

A suspension of *B. coli* was irradiated with a specific dosage of x-rays so as to bring about an increase in volume *per bacterium*

Any change in the optical properties of the irradiated suspension as compared with a normal suspension was measured by means of a spectrophotometer

During like intervals of the phase of logarithmic growth, the spectrophotometric values of optical density and the actual bacterial total counts of a suspension bore a constant relation to each other, such that

$$B = C \left[\frac{I_0}{\bar{I}} \right]^k$$

The total volume per average normal bacterium was measured under the microscope, and found to be 0.75 cubic micra, the total volume per average irradiated bacterium was measured in a like manner, and found to be 2.00 cubic micra

The swelling of the irradiated bacteria was divided into two components (1) enhanced growth, or increased protoplasmic volume, (2) swelling caused by water absorbed from the medium

Assuming the absorption coefficient of the irradiated suspension to be equal to

that of the normal suspension, it was possible to calculate the effective volume per average irradiated bacterium, *i.e.*, the total volume minus the volume attributed to water inclusion. This calculation was restricted to the phase of logarithmic growth when the bacterial counts of the two suspensions were equal

The effective volume per average irradiated bacterium was calculated for one experiment (Table I) to be 0.85 cubic micra by one method, and 0.86 cubic micra by another, the effective volume per average normal bacterium was assumed to be equal to the total volume, *i.e.*, 0.75 cubic micra

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A SIMPLIFIED MECHANICAL METHOD FOR RADIOGRAPHIC MENSURATION AND LOCALIZATION¹

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THE radiographic mensuration of anatomical structures and the localization of foreign bodies are two things the roentgenologist is frequently called upon to do, and for the performance of such work numerous methods have been

localization by this procedure it is necessary to know only three things

- 1 The anode-film distance
- 2 The tube-shift distance
- 3 The point at which the projected rays strike the film perpendicularly

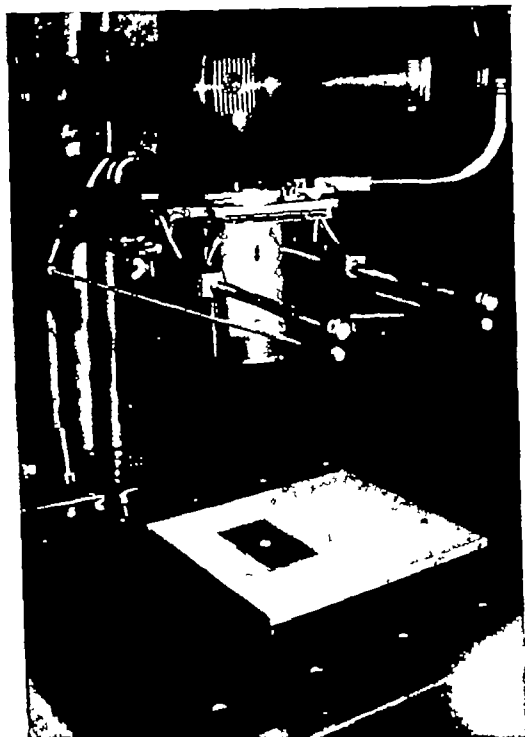


Fig 1 The periscope replaces the cone in the tube carriage. A mirror with a hole and a marker in the center is placed on the cassette

devised. Former methods have not been wholly satisfactory because of the complicated technic and mathematical computations involved. A method which is simple, accurate, rapid, and which is free of all mathematical computation has long been desired by roentgenologists. Such a method has been devised and is described herein.

In order to do either mensuration or

¹ Clinical demonstration given at the Annual Meeting of the Radiological Society of North America Dec 3-7 1934

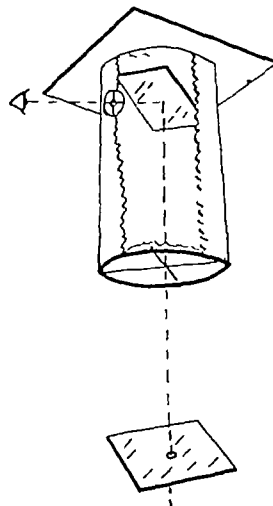


Fig 1-A The construction of the periscope and the mirror

The first two are obtained directly from the scales on the x-ray apparatus and the third is found quickly with a periscope and a mirror. The periscope (Fig 1) is an aluminum tunnel approximately two inches square and eight inches in length. To one end of the tunnel is attached a metal base similar to the base of an x-ray cone. Near the top but inside the tunnel a mirror is placed at a 45° angle. There is an opening about one inch in diameter in the wall of the periscope opposite the face of the mirror. This opening contains two guide lines crossing one another at right-angles. A similar pair of lines is contained in the lower end of the tunnel.

The mirror to be used in conjunction with the tunnel periscope (Fig 1) is three inches square. In the center is a hole

black strings. The strings are held taut by means of weights.

A transparent ruler commonly called a



Fig 2

Fig 2-A

Fig 2 A mensuration table with pseudo-targets adjusted to the horizontal shift

Fig 2-A A mensuration table with pseudo targets adjusted to the vertical shift position

one-eighth inch in diameter and around this hole a white marker one-half inch round.

The periscope and mirror are used only in the making of the radiographs. To read the radiographs a mensuration table and ruler are needed.

The mensuration table consists of a horizontal view box with an upright post attached at one side. This post carries two horizontal rods which extend to the center of the view box. Clamps make possible the fixing of these rods at any desired height above the mensuration table, which is the surface of the view box. The distal ends are called pseudo-targets and represent the target of the x-ray tube in its two positions. Figure 2 shows the two pseudo-targets attached to a single arm which permits horizontal placement of the targets at any desired height above the table. To one pseudo-target is attached two white strings and to the other two

"transpare" is used to measure the desired distances as reconstructed on the mensuration table.

Making the Radiograph—Select any convenient point on the film holder, cassette, or flat-top Bucky diaphragm. If a curved-top Bucky diaphragm is used, select a point on a line which bisects the diaphragm. Place the center of the mirror over this point. Raise the tube carriage to 20, 25, 30, or 35 inches above the film, depending upon the requirements of radiography. Place the periscope in the tube carriage and adjust it until the two sets of guide wires, the center of the mirror, and the reflected guide wires are in line (Fig 1-A). Make a mark on the cassette through the hole in the mirror. Remove the mirror and place a metal marker on this mark. Place the patient or object to be measured in the usual position for taking an ordinary radiograph. If a one-film, double-exposure technic is used, the

film is under-exposed about one-third. After the first exposure the tube is shifted in any convenient direction by means of

A pseudo-target is located directly over this mark at the height of the true target when the first exposure was made. The

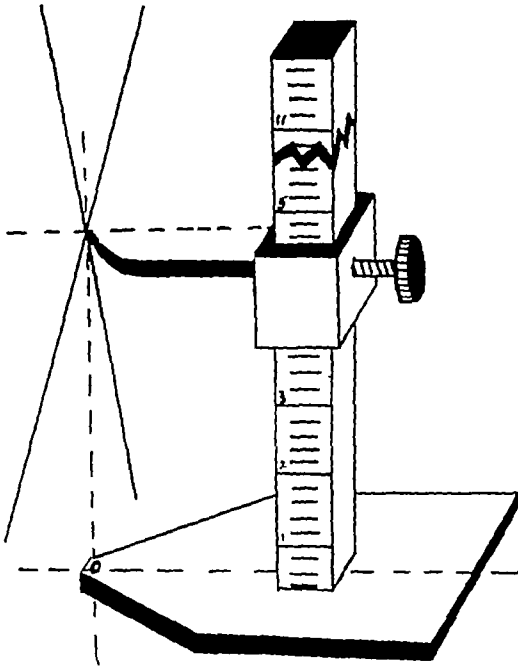


Fig 3 This measuring gauge locates the point on the film directly below the two cross lines. This distance is also read directly from the scale.

the adjustments provided on the machine, if vertically, 5 or 10 inches, if horizontally, a multiple of one inch but not more than 15 inches. Then re-expose. When the shift is made in the vertical direction, proper correction should be made in the length of exposure time to obtain the same density of radiographs for the two positions.

When a Bucky diaphragm is used the shift of the tube carriage between exposures is either in the longitudinal or vertical direction. If no Bucky diaphragm is used, the shift may be in a longitudinal, lateral, or vertical direction. If radiographs are made with the films on an angle, the shift must be lateral.

Reading the Radiograph—The finished film or films are so placed that the mark indicating the point where the perpendicular ray strikes the film on the first exposure is directly over the center of the view box.

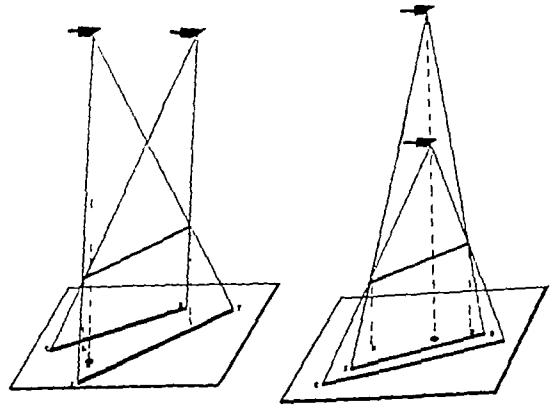


Fig 4. These diagrams show the paths of the rays when the tube is shifted either horizontally or vertically.

strings from this pseudo-target are so placed that they extend directly from the pseudo-target to the extremities of the image. Likewise the second pseudo-target is so adjusted that it holds the same relative position as the true target held during the second exposure. The strings from this pseudo-target are similarly extended to the ends of the second image. Two points are established where the white lines cross the black lines; these two points indicate the position of the object and the distance between the points is its length. A ruler held between these two points indicates the length directly. A ruler held perpendicularly to the film from either intersection indicates the distance of this point from the film. In localization, this distance represents that between the film and the corresponding point in the foreign body. A measuring gauge (Fig 3) with a special base is designed for this use.

The Basis of the Method—The basis of this method is mechanical correction of distortion, the greater the distortion the more accurate the method. For explanatory purposes let AB (in Fig 4) be any object *not* parallel to the film and whose length we wish to determine. E is the point where the perpendicular ray from

the target *O* strikes the film, as found with periscope and mirror. On first exposure *CD* represents the distorted

pregnancy for two reasons first, the patient is not subjected to long exposures, second, measurements of the fetal head



Fig 5 These two superimposed radiographs of a female pelvis were taken at a distance of 30 inches with a 4-inch shift. The mark *X* shows where the perpendicular ray passed through the patient.

or magnified shadow of *AB*. *X* represents the position of the target on the second exposure. *YZ* is the distorted shadow of *AB* on the second exposure. *AN* and *BM* represent the distance of the ends of the object *AB* from the film.

After the radiographs are made, according to the technic given above, the paths of the rays are reconstructed on the mensuration table. The desired distances *AN* and *BM* may then be measured directly with a ruler.

CLINICAL APPLICATION

Pelvmetry—The internal measurements of a pelvis can be obtained readily by this method. The fact that the pelvic inlet plane is at an angle of 30 to 35 degrees with the film makes no difference. The technic is similar to that used in making stereoradiographs of the kidney area.

In pelvmetry it is desirable to make the radiographs during the first trimester of

near the end of the third trimester can be obtained better by different positioning and shifting the tube than that recommended for pelvmetry.

The tube is centered by means of the periscope so that the perpendicular ray will strike about four inches from the top of the film. The patient is then placed so that the perpendicular rays will pass through the line joining the iliac crests. The tube is then shifted two to four inches to the left at the desired height (20, 25, 30, or 35 inches) before the first exposure is made. Before the second exposure the tube is shifted the same distance to the right of its original or perpendicular position.

Figure 5 shows two superimposed radiographs of a female pelvis taken at a distance of 30 inches with a 4-inch shift, 2 inches to each side of the perpendicular position.

When the radiographs are placed on the mensuration table the desired distance between any two points can be readily

obtained by following the procedure already described

The following distances are usually desired

It is obvious that the shift of the tube should be made as nearly at right-angles to the diameter which the operator wishes to ascertain with the greatest ac-

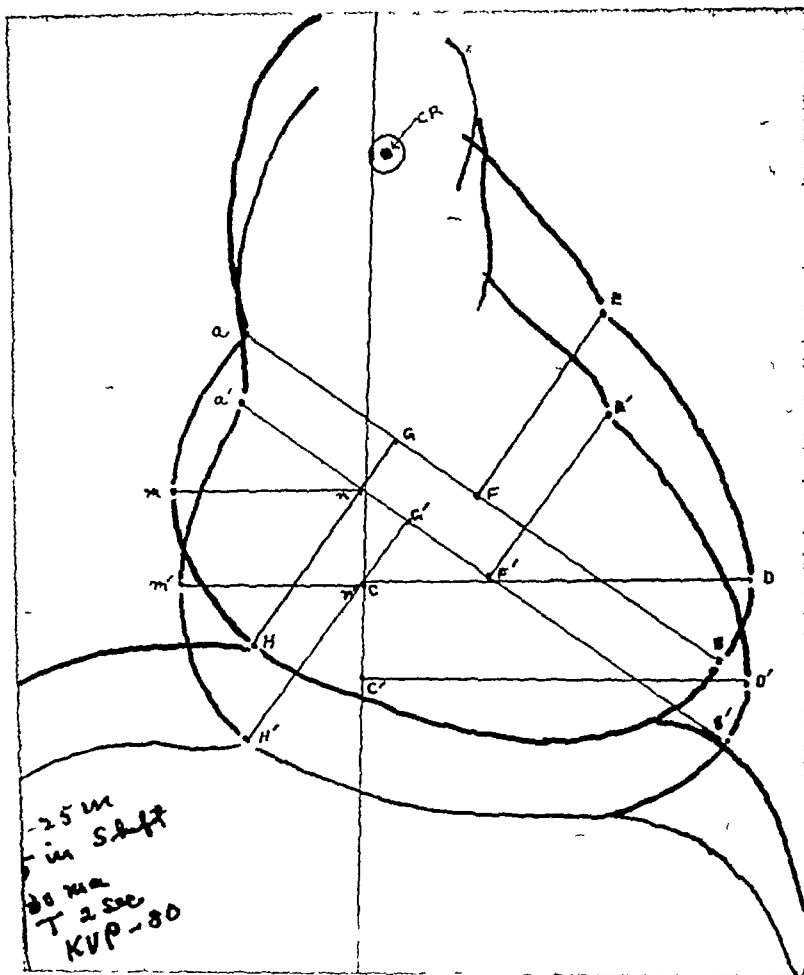


Fig 6 A tracing made from two superimposed radiographs of the heart. These radiographs were made at a 25-inch distance with a 5-inch shift. The exposure time was 2 seconds.

- 1 That from the promontory of the sacrum to the nearest inner surface of the symphysis,
- 2 The internal right oblique,
- 3 The internal left oblique,
- 4 The bi-spinous

Fetal Cephalometry—In many cases it is desirable to perform x-ray cephalometry at the end of the third trimester of pregnancy. The position of the fetal head at this time will determine the position and shift of the

curacy. If this is not practical, the vertical shift can always be resorted to. Usually the first exposure is made at a 25-inch distance and the second at a 35-inch distance. The perpendicular ray is directed somewhere below the pelvic brim. If the fetal position is occiput right anterior or occiput left posterior, the perpendicular ray should strike the patient in the left inguinal region. For occiput left anterior and occiput right posterior, the perpendicular

lar ray is directed to the opposite inguinal area

Fetal cephalometry is reliable only if one can identify certain landmarks of the fetal skull on the radiograph. It is also important that the fetus does not move between exposures—if the fetal head is engaged there is little danger of motion.

Heart (Cardiography)—The measurement of the size of the heart is simplified by this device. Two exposures of the chest at a distance of 25 inches or more with a 5-inch shift give excellent radiographs. Figure 6 shows a tracing made from two superimposed radiographs of the heart. The time of exposure is lengthened so that the heart beats through one complete cycle. This makes it possible to obtain always the largest diameter during diastole. Table I gives the important standard measurements.

TABLE I²

(ABBREVIATED)

HEART MEASUREMENTS ACCORDING TO DIETHEN

Age	Height cm	Weight lbs	T D cm	L D cm
Up to 15 years	100-110		8	8 5
	110-120		8 8	9 2
	120-140		10	11
Men	150-160	40-50	12	13
	160-180	50-75	13	14
	180	75	14	15
Women	145-155	40-50	11	12
	155-165	50-60	12	13
	165	60	13	14

² From *Recent Advances in Radiology*, Peter Keeley P. Blakeston & Son & Co. Philadelphia 1931.

Radiographs taken at a later date for comparison need not be made at the same distance or shift. A slight rotation of the patient makes no difference in the end-results. The only requirement is that the patient must be in the same (upright or supine) position as when previous measurements were made.

Table II is presented to show that a wide variation exists between measurements made in the two different positions.

From this table one concludes that there is a definite relation in 80 per cent of the cases of cardiac length to body length with

the patient supine, and only 59 per cent when the patient is in the standing position.

Foreign Body Localization—This method is ideal for the localization of foreign bodies which are opaque to the x-ray. A foreign body can be localized either from the an-

TABLE II³
(ABBREVIATED)

	Position	Value	Number of cases in the range 95-106 100 being taken as representing mean value
Heart length	Lying	0 0839	80
Body length	Standing	0 0755	59
Heart width	Lying	0 0639	74
Body length	Standing	0 0573	58
Heart length	Lying	1 32	63
Heart width	Standing	1 32	52
Heart length lying over to standing			
Heart length standing		1 12	75
Quotient body length over transverse diam of the thorax	Lying	6 50	72
	standing	6 84	70

³ From abstract of L. Moritz article in *General Medicine (Practical Medical Series)*, 1932, page 618. Year Book Publishing Co., Inc., Chicago.

terior, posterior, or lateral surfaces of the body in which the object is located. It can also be localized from one or more points on the same surface.

The tube is centered and the perpendicular ray point marked on the film holder. Two or more small lead markers are placed on the patient in the neighborhood of the foreign body. The exposures are made at any convenient height and shift. Two exposures can be made, usually on one film.

After the film is placed on the mensuration table two of the cross lines are used to mark the location of the foreign body, while the other two show the position of the lead marker on the surface. The location is then mapped out on the patient's body. Figure 7 shows the location of a foreign body in the thigh of a patient.

Nearly all other uses of mensuration or localization fall under one of the groups described above. A number of other measurements which may be determined with a remarkable degree of accuracy are

(a) The size of abscessed cavities and tumors of the lung

(d) Width of the facial bones (Very important before sphenoidectomy)

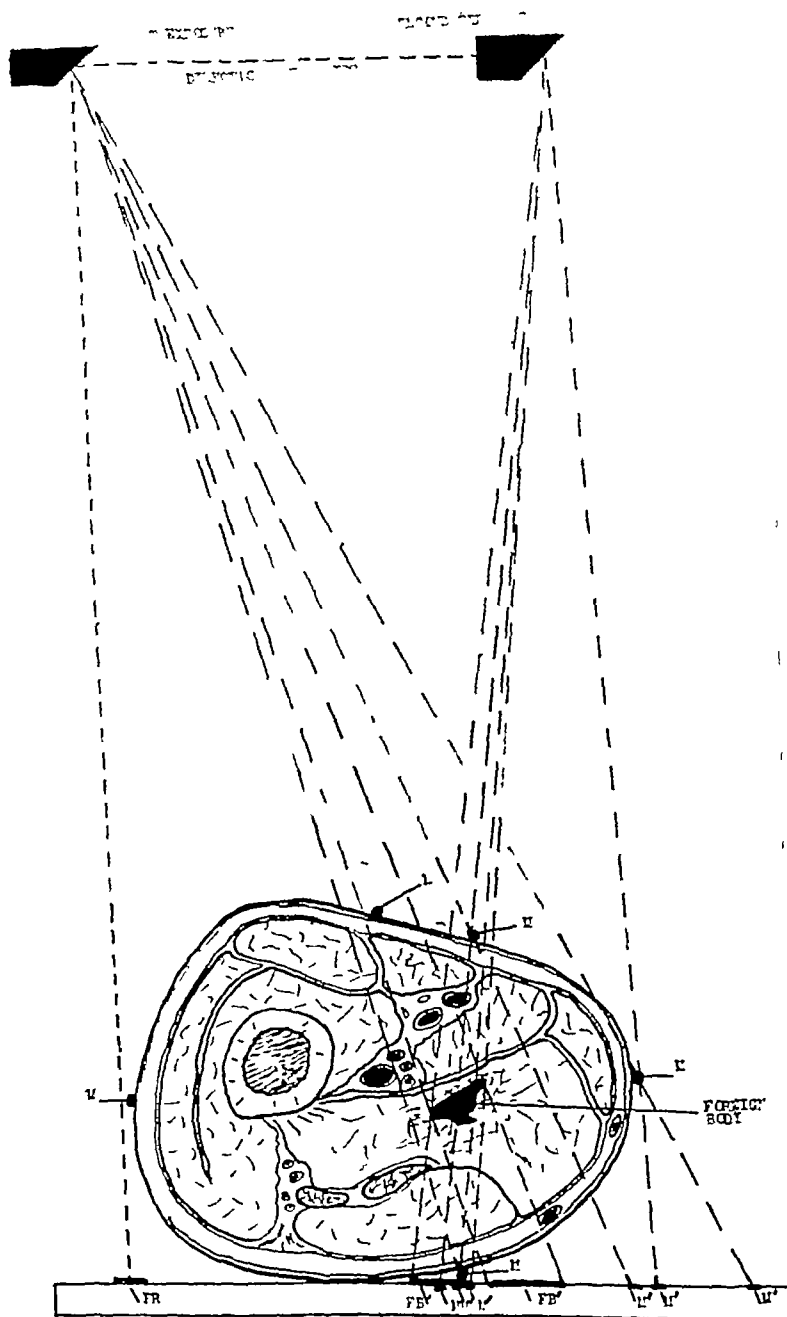


Fig 7 The localization of a foreign body in the thigh of the patient. The marks *M* are markers on the surface of the thigh any one of which can be used as a landmark.

(b) The width of the sella turcica
(c) Whether impacted teeth are lingual or buccal

(e) The shortening of bones from the overlapping of fragments
(f) Distance between fragments of bone

- (g) Width of thymus gland
- (h) Size of internal tumors under treatment
- (i) Depth of objects like kidney stones, gallstones, etc
- (j) Foreign bodies in the eye

which can be applied to the entire field of mensuration and localization in radiography

2 It is simple, accurate, and free of all mathematical computations

3 The apparatus required can be attached to any x-ray equipment now in use

CONCLUSIONS

- 1 A universal method is presented

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DIVERTICULA OF THE FUNDUS OF THE STOMACH¹

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AS COMPARED with other portions of the gastro-intestinal tract, particularly the colon and duodenum, diverticulum of the stomach is usually considered as a relatively rare condition. Tupper (1), who reviewed the literature in 1923, could find only 37 cases described and to these he added one of his own. He credited the original description to Helmont, in 1804, but most of the cases have been reported since the use of roentgen rays, particularly during the past twenty years. Likewise, Nauwerck (2), in a review of the material from about 15,000 autopsies, could find but two cases, and other writers comment on the extremely infrequent occurrence of this condition. As with other supposedly rare lesions it is probable that many cases have been diagnosed by radiologists but have never been reported. At a meeting of the x-ray section of the Wisconsin State Medical Society, in 1931, when this subject was up for discussion, Dr Frank Mackoy, of Milwaukee, stated that he had records of twelve cases and several other radiologists present had each seen one case. To my knowledge, none of these have been published. It is very likely, therefore, that the reported cases represent only a portion of those diagnosed. In the diagnostic x-ray section of the Department of Radiology of the University of Wisconsin, six cases of gastric diverticula have been observed. During the four years in which these were seen, approximately 5,000 patients have been examined by means of a barium meal. This gives an incidence of 0.12 per cent, or slightly more than one case per thousand. During this same period four cases of Zenker's pharyngoesophageal diverticulum have been ob-

served, giving some idea of the relative frequency of these conditions as found in this clinic.

CLASSIFICATION AND ETIOLOGY

As with diverticula elsewhere, those occurring in the stomach may be classed as either true or false. The true diverticulum consists of an out-pouching of the gastric wall and contains all of the coats of the stomach, although these may, at times, be considerably thinned out. The false diverticulum consists of a herniation of one coat through a tear or hole in another, usually the mucosa through the muscularis. One may also consider diverticula as being either of congenital or acquired origin. The latter might be of either the traction or pulsion type.

In a majority of the reported cases the location has been in the cardiac end of the stomach, practically all of these having occurred on the posterior wall near the cardiac orifice. In the remaining cases, the location has been in various parts of the body and antrum of the stomach, there being no particular site of predilection. In this latter group are cases due to hair balls or other foreign bodies in the stomach, traction diverticula due to adhesions, a few with myomas in the walls, and a few showing remnants of pancreatic tissue. The etiology of this last group is uncertain but they may be congenital. Pseudo-diverticula, the result of ulceration or operative procedure, may also be put in this general group. It appears, then, that those occurring on the posterior wall of the fundus are a distinct entity and probably have an etiology peculiar to them alone.

The earlier writers on the subject usually considered all gastric diverticula as being of congenital origin. One reason cited was the fact that in some of the lower

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animals, especially the pig, a diverticular-like out-pouching of the fundus was of frequent occurrence and was to be considered normal. Also, as Keith (3) observed the stomach itself develops as a

blood vessels enter the stomach wall at this point causing further structural weakness in the muscular coat. Kalbfleisch compares this area to that in the posterior wall of the pharynx where Zenker's di-

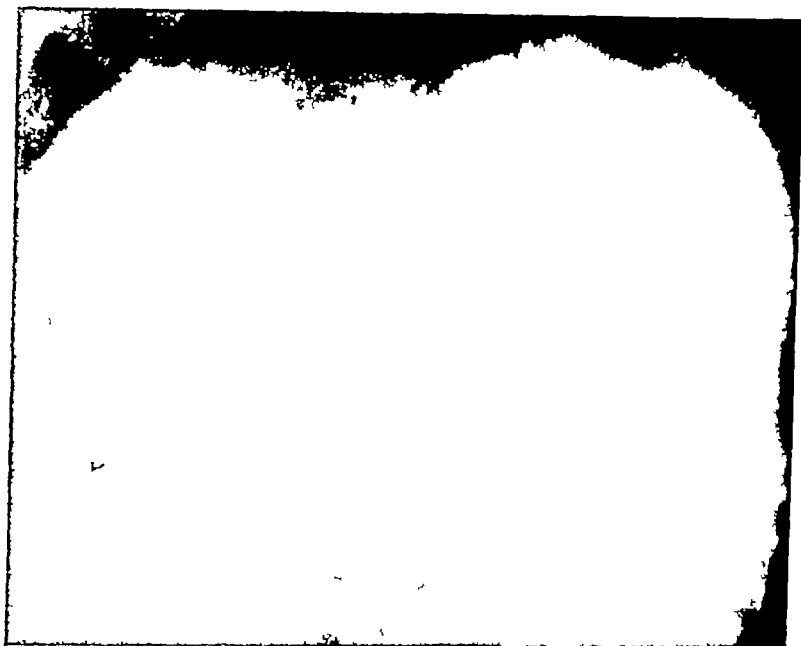


Fig 1 Case 1 Typical shadow of barium filled diverticulum. Note narrow neck connecting pouch to stomach.

diverticulum of the foregut. However, in recent years the opinion seems to have changed and, as pointed out by Bell and Golden (4), most observers now subscribe to the view of an acquired origin. This is explained on the basis of a structural weakness of the stomach wall at this point since, as stated above, most of these diverticula develop on the posterior wall of the fundus. Kalbfleisch (5), in reporting a case, elaborated on this feature. He states that anatomically the longitudinal muscle fibers, as they extend toward the cardia, tend to divide into the two following main courses: one spreading over the fundus and running along the greater curvature, the other bundle following the lesser curvature. Likewise, the circular coat, while, being thick and abundant at the pylorus, tends to become thinned out over the fundus. The oblique layer is also thin in this area. In addition, large

diverticula always appear. It is also pointed out that this portion of the fundus undergoes the greatest strain when food enters from the esophagus. This strain would be aggravated by any increase in intra-gastric pressure either from disease at the pylorus or from reflex spasm. Laurell (6) has a different theory. He believes them to be pulsion diverticula and sees as an essential factor in their formation the intra-abdominal downward pressure which takes place in the upper part of the abdomen when the body is in the upright position. Of 34 cases reviewed by him, 28 occurred in middle aged or older women, and the slack abdominal wall so often seen in these persons was thought to be a factor. This preponderance of females to males is not apparent in the series reported in this paper, there being four males and two females. It is possible that various causative factors enter in different individuals but the most

logical theory at the present time seems to be that which presupposes a point of weakness in the gastric wall as the first essential. The other factors of increased intra-gastric pressure, downward abdominal pressure, etc., may operate secondarily in some cases.

DIAGNOSIS

1 *Symptoms*—The symptomatology is varied. In many cases no symptoms referable to the stomach were present and the diverticulum was found during a routine gastro-intestinal examination. In others, the chief complaint was discomfort in the epigastrium, made worse by eating and relieved by vomiting. There is, however, no constancy in the symptoms. Very often other pathologic conditions are found and when these are remedied the symptoms disappear (Case 6). In only one of the cases observed by us has there seemed to be any relationship between the diverticulum and the symptoms complained of by the patient (Case 4). Several cases have been reported in which carcinomatous degeneration was found at the base of the diverticulum. Moore (7), in a discussion of diseases of the cardiac end of the esophagus and stomach, makes the statement that in a considerable proportion of the gastric diverticula operated upon at the Mayo Clinic cancerous tissue has been found at the tip, but he does not state the number. This fact should be borne in mind, however, in evaluating the symptoms.

2 *X-ray Findings*—The diagnosis, then, is dependent during life upon the roentgenologic examination. This should be relatively easy providing a careful examination is made which includes fluoroscopic observation in the upright and recumbent positions in all diameters. The characteristic finding is that of a rounded or oval shaped pouch with smooth margins connected to the stomach by a narrow neck. The most common location is on the posterior wall of the fundus several centimeters lateral to the cardiac orifice. If the pouch is only partially filled, a fluid level may be seen in the upright position. With the patient in a supine position and

rotated slightly to the left, the typical pouch will be seen to best advantage. In this position, the fundus remains full of barium, the diverticulum is dependent, and some of the opaque substance should enter even though the pouch may be filled with fluid, due to the tendency of barium to sink because of its weight. Barium is often retained at the end of six hours or longer, while the balance of the stomach is empty. Films taken in the horizontal position will show a smoothly rounded, sharp shadow. This finding led to the correct diagnosis in Case 3.

The fact that a diverticulum is not found at operation after being diagnosed roentgenologically does not necessarily mean that the diagnosis was incorrect. Due to their high location and position on the posterior wall, direct visualization is difficult and the opening of the pouch may be so small and hidden in the mucosal folds that it can easily be missed both by the eye and the examining finger, even when the stomach has been opened.

DIFFERENTIAL DIAGNOSIS

From the standpoint of differential diagnosis, a diverticulum must be distinguished from the niche of a penetrating ulcer. If the diverticulum is small this may be difficult, however, ulcers seldom occur in as high a location as diverticula commonly do. They do not show the bulbous sac and narrow neck but are more often rounded, pointed, or irregular, and frequently show spastic manifestations locally or at the pylorus, something that true diverticula do not. Herniation of the stomach through the esophageal hiatus or other parts of the diaphragm must also be considered but may be eliminated by demonstrating that the pouch is below the diaphragm. Diverticulum of the lower end of the esophagus may be ruled out by showing that the pouch has no connection with the esophagus. Pendergrass (8) calls attention to the fact that a diverticulum is larger on inspiration than on expiration, while the opposite is true of a hernia, and that the optimum position for visualizing



Fig 2 Case 2 An illustration of the usual contour of this type of diverticulum Patient in a supine position with right side elevated about 45° This case is similar to Case 1



Fig 3 A six hour film The arrow points to the barium residue in the diverticulum with the balance of the stomach empty This is a common finding

a diverticulum is in the recumbent left oblique posture while a hernia will be best seen in a postero-anterior recumbent or in the Trendelenburg position

CASE REPORTS

Case 1 A white male, aged 49 years was first examined on July 28, 1931. He complained of pain and soreness in the center of the epigastrium which had been present for one week. Similar attacks but not as severe, had occurred intermittently during the past year. The pain was fairly constant, with some increase in severity two to three hours after meals. In recent months he had had considerable worry over financial matters and tended to blame his stomach trouble on his worried mental state. Physical examination revealed nothing of importance except diseased tonsils and a slightly enlarged postate. X-ray examination of the stomach revealed a typical diverticulum of the fundus of the stomach. Otherwise, the gastro-

intestinal tract was normal. The patient later had a flare-up of symptoms of which the neurotic element predominated and he was hospitalized for treatment of the psychoneurosis.

Case 2 W K, a white male, aged 27 years, was admitted to the hospital on Nov 6, 1931, his chief complaint being that of a pain in the left leg since the previous July. He stated that for the past four years he had had attacks every summer of dull epigastric pain, coming on about an hour after meals and associated with nausea. Food usually gave relief. At the time of hospitalization there were no abdominal complaints. The condition in the leg was diagnosed as a sciatic neuritis. X-ray examination of the stomach revealed a diverticulum of the fundus. Otherwise, no pathology was found in the gastro-intestinal tract.

Case 3 Mrs D L, aged 35 years, had been seen on several occasions in the Student Health Clinic where a diagnosis of

rheumatic heart disease with adherent pericardium had been made. Two and one-half years previously she had had a severe attack of pain in the right upper quadrant associated with vomiting. Two similar attacks had occurred since then. Because of this history and for the purpose of a complete physical examination an intravenous gall-bladder test was done. The concentration response was reported as being sub-normal, but without evidence of calculi. Gastro-intestinal examination showed nothing abnormal except that in the film made at six hours a small round fleck of barium was seen in the region of the fundus. This aroused a suspicion of gastric diverticulum and the diagnosis was proved at a second examination.

Case 4 C W, female, aged 43 years, was first admitted to the hospital Dec 28, 1928, at which time a diagnosis of chronic catarrhal colitis, spastic type, was made. There were no symptoms referable to the stomach. She was re-admitted on Dec 29, 1932. There had been little improvement in the bowel symptoms. She had severe constipation and colicky pains in the lower abdomen which were relieved by enemas. She complained of a burning pain beneath the sternum, of four months' duration. There were two distinct areas to which the pain was referred, one high up in the esophagus and the other at the level of the xyphoid process. The pain was present only on swallowing, the patient stating that it felt as if something was obstructing the passage of her food. For the last six months she had spat up at irregular intervals small amounts of bright red blood, never as much as a teaspoonful. Gastro-intestinal x-ray examination revealed a typical diverticulum of the gastric fundus, the patient localized the lower point of pain as directly over this. No other lesions were found in the upper gastro-intestinal tract.

Case 5 C O, white male, aged 55 years, was admitted to the hospital on Dec 26, 1932. The chief complaint was epigastric pain. Two years previously there had been a sudden onset of momen-

tary dizziness upon suddenly arising, also, a dull aching pain in the epigastrium. The pain, which was never very severe, became worse when the man was hungry and was relieved for two to three hours after taking food. There was no night distress. The clinical findings led to the diagnosis of arteriosclerotic cardiovascular disease, myocardial degeneration, relative mitral insufficiency, aortitis, and emphysema. X-ray examination of the stomach showed a diverticulum of the fundus. The gall bladder revealed a normal function after the oral dye test. The abdominal symptoms were thought to be due to the well marked cardiac pathology.

Case 6 C H, white male, aged 48 years, whose chief complaint was "gas in the stomach." He had been operated upon eighteen years previously for ulcer. About ten years ago he began having a recurrence of pain, although not severe. Eight years ago he vomited a large amount of blood. Since then he has had intermittent pain after meals, relieved by food, and much gas. Three weeks previous to admission he had suffered a severe attack of diarrhea and the pain was more intense, but this attack had largely subsided. Gastro-intestinal x-ray examination revealed a gastro-colic fistula and a small diverticulum of the fundus of the stomach. The patient was operated upon and the fistula repaired. No attempt was made to find the diverticulum. The patient recovered and was discharged, greatly improved. This is the only case in the series in which disease was found elsewhere in the stomach which might have affected the intra-gastric pressure. In none of the other five cases was there any evidence of obstructive lesions or spasm at the pylorus.

SUMMARY

1 Six cases of diverticulum of the fundus of the stomach are reported with brief case histories.

2 The etiology is uncertain. The most logical assumption is that these are pulsion diverticula due to an inherent

weakness of the gastric wall at this point, possibly coupled with other mechanical factors such as strain on the gastric wall from food entering from the esophagus and increased intra-gastric pressure in some cases

3 The symptomatology is varied and in many cases the condition is probably asymptomatic. In only one of the cases reported in this paper did there seem to be a definite connection between the symptoms complained of and the diverticulum.

4 The roentgenologic and differential diagnoses are discussed.

5 The importance of recognizing these lesions lies chiefly in the necessity of differentiating them from other and possibly more serious conditions.

Note—Since submitting this paper for publication, another case of gastric diverticulum has been observed. The x-ray findings were similar to those illustrated. The patient was operated upon and the diver-

ticulum resected. A badly diseased gall bladder was also found and removed.

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BASOPHILIC ADENOMA (PITUITARY BASOPHILISM)

REPORT OF A CASE, WITH CLINICAL IMPROVEMENT OF SYSTEMIC MANIFESTATIONS AFTER IRRADIATION OF THE PITUITARY

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IT WAS Erdheim (1) who first called attention to the existence of basophilic adenoma, however, it remained for Cushing to bring to light the clinical significance of these tiny lesions of the pituitary and to reconstruct a clinical entity which is best known as Cushing's basophilism. For the full story of the disease one needs necessarily to consult the writings of Cushing (2)

Pituitary basophilism as defined in Cushing's writings (3) is characterized by a rapidly acquired obesity which affects chiefly the face, neck, and trunk, hypertension, demineralization of bones of the skeleton, and purplish striae of the abdomen are additional characteristic features of the disease. In women, hirsutism and amenorrhea are commonly observed. It is to be emphasized that without a postmortem verification, the diagnosis of the malady may be questioned. It may be confused clinically with hyperadrenalism of the cortical type and in some instances it has led to an exploration of the adrenal gland. The clinical features and the progress of the disease in the patient who has been under our observation at the Temple University Hospital were so strikingly characteristic of "basophilism" that it appeared justifiable to place the case on record even though the diagnosis has not been verified by postmortem

CASE REPORT

Miss J W, age 23 years, single, white female, came to the Temple University Hospital because of pain in the lower third of the right tibia and right foot and ankle, and rapid gain in weight (having gained twenty-five pounds in the past nine months). She was also bothered with swelling of both ankles. The pain in the



Fig 1 J W, pituitary basophilism (unverified), showing adiposity (chiefly abdominal), striae, and hirsuties

right lower extremity had commenced three years before admission and gradually became worse. At first the pain was limited to the right foot and then extended to the ankle and lower right tibia. The pain was of a dull, aching character, aggravated by walking or standing.

In addition to the above mentioned pain, she complained of stiffness and pain in the left knee, of much milder degree. The swelling of the ankles was of nine months' duration, always worse toward evening. About eight months after the onset of the



Fig 2 Rather large defects can be seen in the first, third and fourth metatarsal bones and in the first terminal phalanx. This film was made shortly after admission and before x-ray treatment.

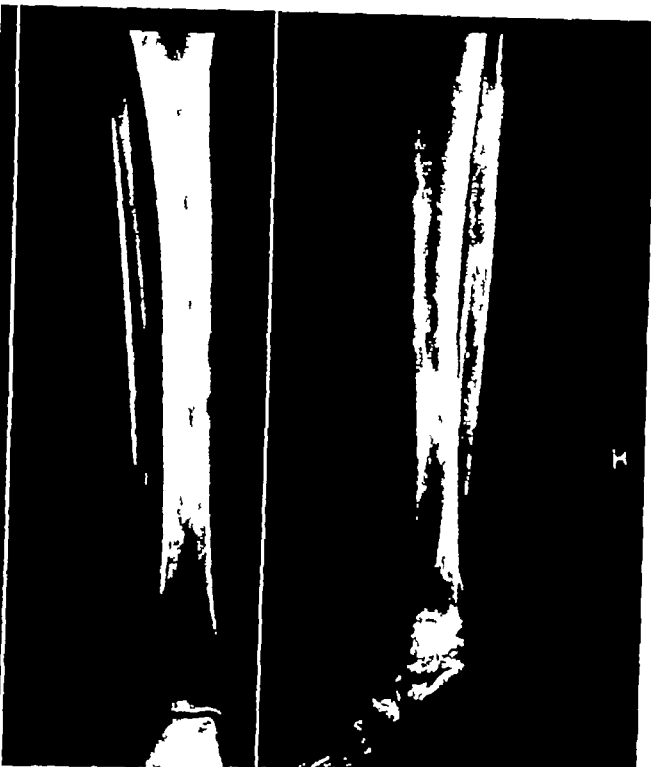


Fig 3 The sharply circumscribed defects in the tibia can be seen throughout the shaft of the bone. Roentgenograms made before treatment.

illness there developed a "soft tissue tumor" on the right ankle and another similar tumor appeared a few months later on the calf of the right leg. Both of these tumors were removed and found to be lipomas.

During the past year she had developed shortness of breath, a growth of fine hair on the upper lip and the under-surface of the chin, and on two occasions dizzy spells that lasted three days. She noticed a steady, progressive gain in weight, having gained twenty-five pounds in the past nine months. Her past history is irrelevant except that she had the customary diseases of childhood and also suffered from sore throats for many years. Her menses started at the age of twelve, lasting seven days and accompanied by considerable dysmenorrhea. In the past fourteen months the menstrual flow had become scant and the periods irregular.

Physical examination showed an obese, sluggish young woman, 5 feet 4 inches in height and 232 pounds in weight. The face was round and the site of an old acne with considerable scarring and pitting. There was a thin growth of hair on her upper lip and chin. The obesity was of generalized distribution but predominated over the hips, abdomen, and thighs, while her legs and arms were disproportionately thin for her face and trunk. The breasts were pendulous. The skin was dry and there was a growth of hair from the symphysis pubis to the navel. On both lateral and anterior aspects of the lower half of the abdomen prominent purplish striae were present.

Examination of the heart and lungs revealed no abnormalities. The blood pressure varied from 155/85 to 140/90. The pulse rate ranged from 80 to 100. Examination of the eyes showed that the vision

in the right and left eyes was 20/30. Examination of the visual fields by the campimeter revealed a sector-like constriction in the right upper temporal field and slight constriction in the left upper temporal quadrant. The fundi and media were normal.

The basal metabolic rate was minus 26 per cent. She had a high tolerance for carbohydrates. Oral administration of 100 grams of glucose caused a rise in blood sugar in one hour to 114 mgm per 100 c c of blood, but this figure dropped to 105 mgm at the end of the third hour. The blood cholesterol was 180 mgm per cent. The blood calcium was 11.5 mgm per cent and blood phosphates 4 mgm per cent. The results of the blood count were hemoglobin, 13 grams, red blood cells, 4,550,000, leukocytes, 9,050, neutrophils, 50 per cent, eosinophiles, 2 per cent, monocytes, 2 per cent, lymphocytes, 46 per cent. The Wassermann test was negative. The urine contained a trace of albumin, no formed pathologic elements were found microscopically.

X-ray examination of the right foot showed areas of rarefaction in the metatarsal bones and phalanges (Fig 2). X-ray examination of the right leg showed similar areas of rarefaction in the tibia (Fig 3). Roentgenograms were made of the ribs, dorsal and lumbar spine, and the skull, but these portions of the bony skeleton were normal. The sella turcica was entirely normal in size and shape.

Course of the Disease—The patient was placed on a diet of 1,500 calories. Desiccated thyroid was given three times a day, the dose at first being one-half grain, increased to one grain. During two weeks of treatment she lost about five pounds in weight, the pains in the legs and dizziness were still present and the feeling of not being "quite well" persisted. The basal metabolic rate rose to minus 17 per cent. The blood pressure remained on the same level as when she was first examined. She was given a series of x-ray treatments, 250 r to each side of the cranium at the first visit and 100 r at weekly intervals

thereafter, until six treatments had been given in all. The exact position of the

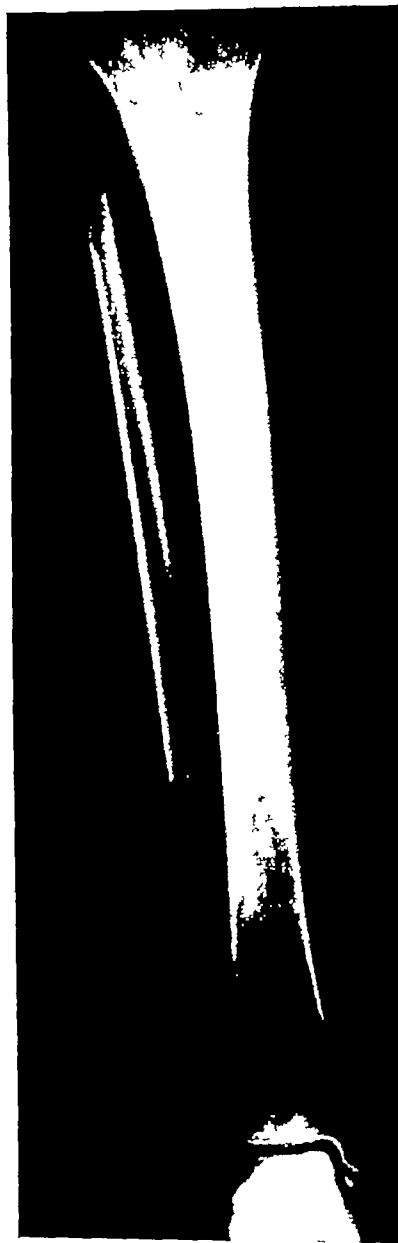


Fig 4-A. Roentgenogram made nine months after a series of x-ray treatments to the pituitary gland. The demineralized areas in the tibia are so completely filled in by new bone that their original sites are difficult to determine. See also Fig 4 B.

sella turcica was determined by roentgenograms and fluoroscopy of the skull.

Her general condition promptly improved—the blood pressure decreased,



Fig 2 Rather large defects can be seen in the first third and fourth metatarsal bones and in the first terminal phalanx. This film was made shortly after admission and before x ray treatment.



Fig 3 The sharply circumscribed defects in the tibia can be seen throughout the shaft of the bone. Roentgenograms made before treatment.

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The visual fields were found to be moderately contracted

A series of roentgen treatments to the pituitary gland brought about deposition of lime salts in the demineralized bones and a striking improvement in the patient's general condition. That the patient showed a polyglandular syndrome is evident. Without a postmortem verification it is hazardous to state which gland was chiefly responsible for the endocrinological signs. However, the fact that irradiation of the pituitary gland brought about not

only calcification of the osteoporotic bones, but also improved the patient's general condition would induce one to favor the pituitary gland as playing the primary rôle in the patient's malady.

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 - (2) CUSHING HARVEY Bull Johns Hopkins Hosp March 1932 50, No 3
IDEM Arch Int Med, 1933, 51, 487
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the pain in the right lower extremity markedly diminished, her weight rapidly went down to 215 pounds (on the day treat-

patient was discharged from the hospital and is attending the Endocrine Clinic. On her last visit, her weight was 187



Fig 4-B See caption of Fig 4-A

Fig 5 Roentgenogram of the right foot nine months after x-ray treatment. Note that the rarefied areas have been replaced by new bone

ment was commenced weight was 225 pounds) Roentgenograms of the right foot and right leg, made two months after the completion of the series of x-ray treatments, showed that the areas of rarefaction had become much smaller due to filling in of new bone. Mineralization was so marked that the bone appeared quite dense. A recent roentgen examination of the right foot and leg (11 months after the original examination and 9 months after the x-ray treatments to the pituitary) shows scarcely any defects in the bones (Figs 4 and 5). Her menstruation became regular and of normal flow. The

pounds and she had no subjective complaints.

SUMMARY

To summarize the clinical picture of the case, we find a young obese woman with a moderately elevated blood pressure who presented herself to the clinic because of pain in the right lower extremity and edema of both ankles. In addition, she showed hirsutism and scanty, irregular menstruation. The outstanding positive laboratory findings were decalcification of bones of the lower extremity, low basal metabolic rate, and increased carbohydrate tolerance.

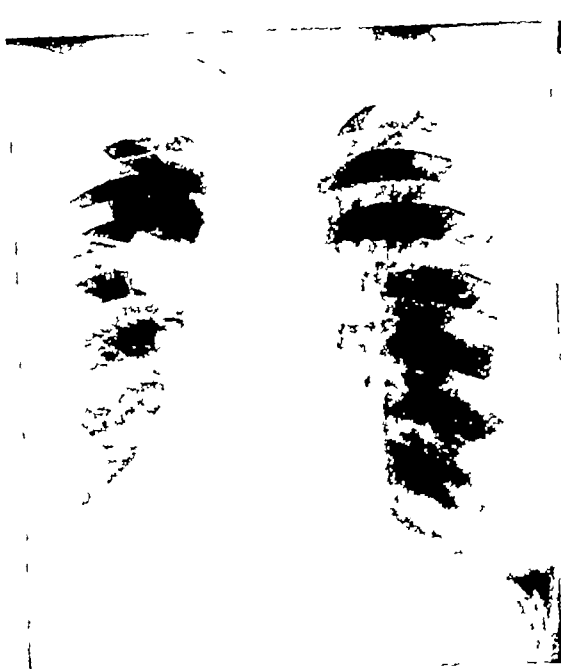


Fig 3 After four years of pneumothorax the lung is gradually re-expanding

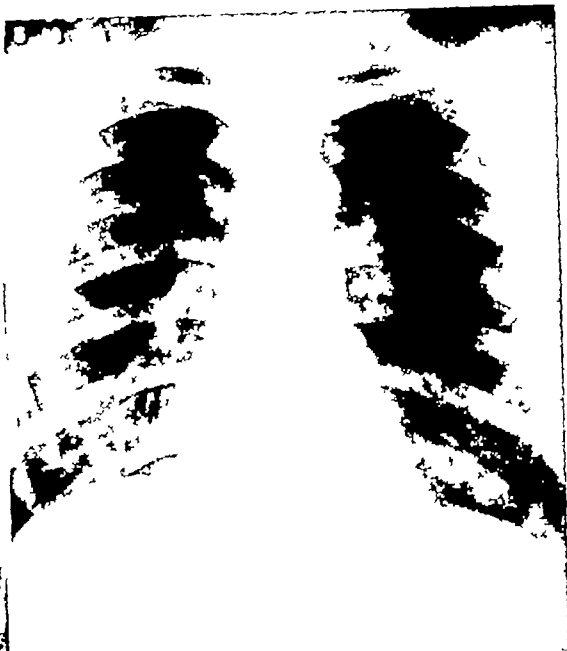


Fig 4 Central cavity, right side

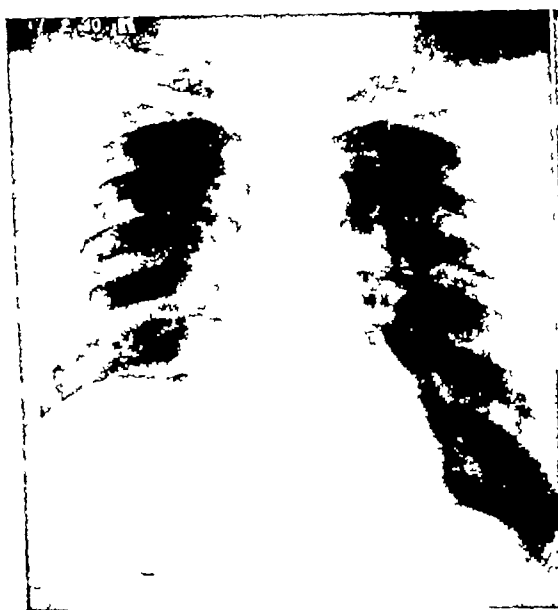


Fig 5 Same case one month later Cavity completely closed by phrenic paralysis



Fig 6 Pneumothorax failed to close large cavity

given the patient, through the results of surgical procedures. This enthusiasm has reached the patients and good results have been reported to them, and they not infrequently request surgical intervention for themselves.

We thought it might be of some interest to find out if any definite conclusions could be arrived at from the study of a number of cases treated within the past four years. We selected, therefore, the productive type of lesion, or those types most difficult

THE MANAGEMENT OF THE PRODUCTIVE LESION IN PULMONARY TUBERCULOSIS¹

A STUDY OF 500 CASES

By C C BIRKELO, M D, and S M GELENGER, M D, Herman Kiefer Hospital, Detroit, Michigan

IN THE past few years we have witnessed some marked changes in the treatment of pulmonary tuberculosis. The application of surgery in this field has become more and more common and to-day it would be almost impossible to begin the

of treatment to be used here is just as difficult as in any other field of medicine. The individual patient presents a problem all of his own which must be solved before the most successful measures can be instituted.



Fig 1 Unilateral lesion The productive type predominates

Fig 2 Pneumothorax is well established The cavities are closed

treatment of any case of pulmonary tuberculosis without having in mind some surgical procedure. The hopelessness of long-continued bed rest has at last been well nigh universally accepted and a definite attempt has been successfully made to shorten the period of needed hospitalization in all cases, but especially in the chronic types of the disease. In some sections the new idea has been accepted with open arms and in other places, with some reluctance. Attempts at standardization

Those of us who have been concerned with this type of work for a period of considerable length, will easily recall how patients used to be kept in bed more or less, year in and year out, without a great deal of hope for a final cure. They often became disgusted with the chronicity of their hospitalization and not infrequently departed in the dark of the night or by the open window, to shift for themselves on the outside. Such departures at the present time are rare and usually indicate a disordered mentality rather than a disgust with the treatment given. There is a great deal of comfort in the new hope

¹ Presented as a clinic before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis, Tenn., Dec 3-7 1934

productive type of lesion, that is, they were either entirely productive or this type of lesion predominated. All the others admitted were more acute, that is, had either exudative or mixed lesions, in the group in which the exudative type predominated. This does not mean that our present hospital population maintains this same percentage, because we see very often that the exudative lesion changes to the productive type of lesion during the patient's stay in the hospital.

The productive lesion is usually of the neglected type. The patients often give histories of chronic cough and expectoration, so that some other condition has been suspected until an x-ray examination tells the tale. Others have known of their exposures and have neglected to seek treatment until such time as they have become quite completely incapacitated. This latter group offers us little choice in the treatment to be given.

In a few of these extreme cases, some form of collapse therapy was attempted, and they are listed with the others in summing up the results of any form of therapy, thus reducing the percentage of good results. In this series of cases, very nearly every death can be accounted for by neglect in treatment—and we mean neglect by the patient himself.

We divided all cases into three groups, according to the outline given by the National Tuberculosis Association, namely, minimal, moderately advanced, and far advanced.

TABLE I — MINIMAL UNILATERAL (67 CASES)
TREATMENT AND RESULTS

	Bed Rest	Phrenic Interruption	Artificial Pneumothorax	Phrenic Interruption
Total	42	23	1	1
Improved	36	22	1	1
Not improved	6	1		
All sputum tests negative	35	17		
All sputum tests positive	2	1		
Sput. became neg after treatment	5	5	1	1
Expired (enteritis)	1			
Tuberculosis of pleura	1			
Tuberculosis of kidney		1		

Table I includes the minimal unilateral lesions and the great majority of these cases did not show sufficient disease to warrant other than bed rest treatment. Many of these cases were, to all appearances, well arrested and were kept for observation to permit us to study the lesion and to determine, if possible, any tendency to spread or to retrogress. We feel that no matter how minute a lesion may be, if the diagnosis of tuberculosis can be made from an x-ray examination, hospitalization should follow. During a short period of such hospital stay, the lesion can be studied definitely by serial x-ray examinations and a fairly accurate prediction as to the future of the case can then be made. Some readers will probably think that these records show evidence of over-treatment, but we did not think so as we examined the serial films in each case.

The diagnosis of a minimal lesion was definitely made in these cases, on x-ray evidence, and if this evidence is sufficient for a diagnosis, it should also be sufficient as a basis of therapy when, as often happens, other findings are lacking. This is especially true in the acute exudative processes, but it is also true in the productive type of lesion.

TABLE II — MINIMAL BILATERAL (31 CASES)
TREATMENT AND RESULTS

	Bed Rest	Phrenic Interruption	Artificial Pneumothorax
Total	21	9	1
Improved	18	9	1
Not improved	3		
All sputum tests negative	18	8	
Sputum became neg after treatment	3	1	1
Pott's disease	1		
Tuberculosis of pleura	1		
Tuberculosis of ribs	1		

The bilateral lesion becomes a more serious affair, with a fairly equal amount of involvement on the two sides, it is often necessary to use a short period of bed rest, especially when the sputum is negative, before the best type of additional therapy, if any, is decided upon. The main con-



Fig 7 Bv adding phrenic paralysis cavity closed

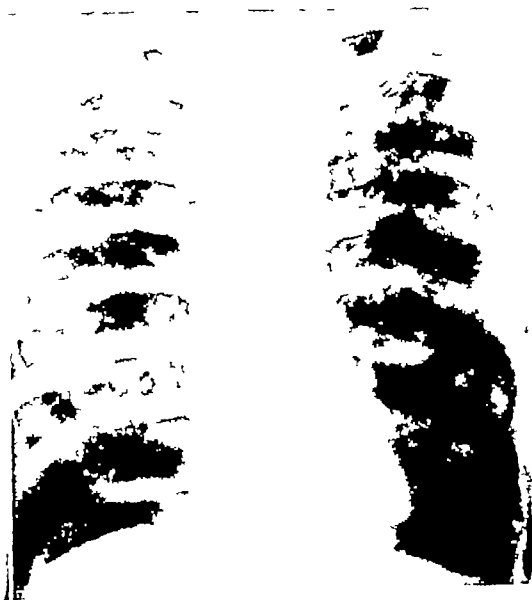


Fig 8 Bilateral large excavations



Fig 9 Same case after one year of bed rest, cavities almost closed

Fig 10 Large cavity upper right Phrenicectomy reduced its size

to treat because of their tendency to chronicity. The entrance x-ray examinations at Herman Kiefer Hospital were reviewed from 1930-1934 and the first 500 cases of productive lesions encountered were selected, regardless of the extent of disease, because we thought their study would furnish a fair cross-section picture

of the fate of the chronic cases. These cases were followed through their entire stay in this hospital and their condition upon departure was tabulated. A follow-up beyond this point has not yet been possible, but it will be reported later.

Of all patients admitted in this four-year period, 23.2 per cent showed the

to bring the lesions under control. Only one-eighth of these cases required as much collapse as a combined phrenic interruption and pneumothorax. Some of these cases had negative sputum and yet there were cavities visible in the x-ray film. These cases were treated just as vigorously as were those with positive sputa, because we have observed that open cavities may yield negative sputum for periods of several months before a positive sputum appears. Much valuable time had then been lost and treatment had become very difficult.

In the bilateral class of this group, we find an increase in the number of cases in which bed rest alone was the most suitable treatment. Extrapulmonary complications or poor physical condition was the cause of such a decision, or a purely fibrotic lesion, showing little if any signs of activity and no excavations, would also be treated in this manner. The usual policy is to find out, first of all, if the side having the largest cavity or the worst lesion will allow

successful pneumothorax, and as soon as that has been determined, immediately give a phrenic crushing to the opposite side. In all cases, an attempt is made to close any and all cavities in the shortest possible time and render the sputum persistently negative. If we have bilateral excavations and bilateral pneumothorax can be used, a phrenic crushing is often added to the side which is slowest in its response to pneumothorax, again attempting to close any gap which may yield positive sputum.

The relatively short time in which a phrenic paralysis may completely close a cavity is so outstanding that there is a temptation, very well founded on experience, to do a phrenic crushing first, in a unilateral lesion, just to see what it may accomplish, and later add additional therapy as needed.

The far advanced group comprises more than half of the entire number and, even in the unilateral group, eight were unable

TABLE V—FAR ADVANCED, UNILATERAL (35 CASES)
TREATMENT AND RESULTS

	Bed Rest	Phrenic Interruption	Artificial Pneumothorax	Phrenic Interruption, Pneumothorax	Thoracoplasty
Total	8	7	6	8	6
Improved	1	4	4	8	4
Not improved	7	3	2		2
All sputum tests positive	8	3	2		2
Sputum became neg. after treatment		4	4	8	4
Cavities present before treatment	5	5	4	8	4
Cavities closed after treatment		4	3	8	4
Expired	3				2
Empyema			1		

TABLE VI—FAR ADVANCED, BILATERAL (225 CASES)
TREATMENT AND RESULTS

	Bed Rest	Phrenic Interruption	Artificial Pneumothorax	Phrenic Interruption, Pneumothorax	Thoracoplasty	Bilateral Pneumothorax
Total	123	21	33	31	10	7
Improved	19	14	18	21	9	2
Not improved	104	7	15	10	1	5
All sputum tests negative	9	3				
All sputum tests positive	106	11	19	16		5
Sputum became neg. after treatment	8	7	14	15	9	2
Cavities present before treatment	69	11	26	17	10	5
Cavities closed after treatment	5	7	15	16	10	
Expired	61	1	8	5	1	1
Laryngitis	5	1				
Genito-urinary tuberculosis		1				
Enteritis	7					
Pott's disease	2			1		1
Meningitis	1					

cern is to produce a persistently negative sputum. An interesting observation to be drawn from Tables I and II is this, that in only one case in the unilateral group did the disease progress under hospital régime sufficiently to require the combination of pneumothorax and phrenicectomy, and in only one case in the entire series did the disease pass out of control. From this, one should be able to conclude that the treatment applied to the minimal lesions must have been entirely successful, inasmuch as there was only one death (enteritis), and the other patients were all considered sufficiently well established toward a cure to be dismissed from the hospital.

TABLE III—MODERATELY ADVANCED UNILATERAL (38 CASES)
TREATMENT AND RESULTS

	Bed Rest	Phrenic Interruption	Artificial Pneumothorax	Phrenic Interruption Pneumothorax
Total	10	19	4	5
Improved	9	17	4	5
Not improved	1	2		
All sputum tests negative	6	7		
All sputum tests positive	1	5		1
Sputum became neg after treatment	2	7	4	4
Cavities present before treatment		4	4	2
Cavities closed after treatment		4	4	2
Expired	1			
Enteritis	1			

The number of colored patients in this series is nearly 10 per cent, which is also about the same as our colored population at this hospital at the present time. Their response to treatment is nearly the same as in the white patients and their stay in the hospital is about the same in length of time. If they did not respond as well as the white and required longer periods of hospitalization for a given type of lesion, we would gradually be accumulating a colored population out of proportion to the white, and this is not the case. In the minimal class, they formed 12 per cent of cases, in the moderately advanced 4 per cent, and in the far advanced group 12 per cent. From these figures, we conclude little except that their inferior living conditions will probably best explain any seeming difference between them and their white neighbors. We have been unable to show any definite difference between races in response to any type of treatment.

In the moderately advanced group, we found 142 cases as against 98 in the minimal group, and of these, only 38 (or about one-third) were unilateral. This shows that in two-thirds of the cases with excavation, or in lesions of sufficient extent to be classed in this group, there is a tendency to involve both lungs, and so complicate the treatment.

Bed rest in the unilateral group was used in only one-quarter of the cases and phrenic interruption was sufficient in just one-half

TABLE IV—MODERATELY ADVANCED BILATERAL (104 CASES)
TREATMENT AND RESULTS

	Bed Rest	Phrenic Interruption	Artificial Pneumothorax	Phrenic Interruption Pneumothorax	Thoracoplasty
Total	48	27	16	12	1
Improved	30	23	12	11	1
Not improved	18	4	4	1	
All sput tests neg	32	10			
All sput tests pos	11	7	8	2	
Sput became neg after treatment	5	10	8	10	1
Cavities present before treatment	4	8	3	3	1
Cavities closed after treatment		7	3	3	1
Expired	5				
Enteritis	2	1			
Laryngitis	2				
Meningitis	2				
Tuberculosis of kidney	2		1		
Peritonitis	1				
Epididymitis	2				

in the white and the colored We believe that inasmuch as this type of lesion is the neglected one, this proportion indicates simply that the male in all races is more likely to disregard the early signs of illness produced by tuberculosis and pass through the more acute stages of the disease before seeking medical aid

These patients were discharged from the hospital only when the disease was under control and no more surgery was indicated Some of them had positive sputum when they were transferred and these include the class that was too old to receive any active treatment and will probably spend the remainder of their lives in hospitals A few left to be deported and some went home against advice Patients doing well with pneumothorax and phrenic paralysis were discharged to convalescent homes and hospitals to continue rest and an inactive type of treatment

The average hospital stay in this group was three and one-half months This does not mean that the disease can be cured in so short a period of time, and several factors must be borne in mind Many in this series died very shortly after entering the hospital Some were too old to receive much active treatment and were transferred to places where they could spend the rest of their days in fair comfort The minimal cases and those considered to be arrested were also often discharged to convalescent homes in the above mentioned

short period of time Those from Groups 2 and 3 who were in condition to receive active therapy were our guests for much longer periods, the time indicated above being simply an average for all types of cases

We have selected roentgenograms to illustrate the various types of treatment used and the results (Figs 1-12)

CONCLUSIONS

- 1 The chronic case in tuberculosis will respond as well as any type to active collapse therapy

- 2 Statistical results of death from tuberculosis are made up mainly from the type of case entered at the hospital in such an advanced stage that nothing can help

- 3 The colored race have the productive type of tuberculosis in about the same ratio as the white, and respond to any treatment as well as other races

- 4 The productive lesion occurs in males nearly twice as often as in females

- 5 There were very few discouraging results or accidents in any group in which active collapse therapy was considered applicable

- 6 Few complications actually contraindicate active therapy

- 7 Very few cases with positive sputum should be treated with bed rest alone, provided their physical condition allows more active therapy

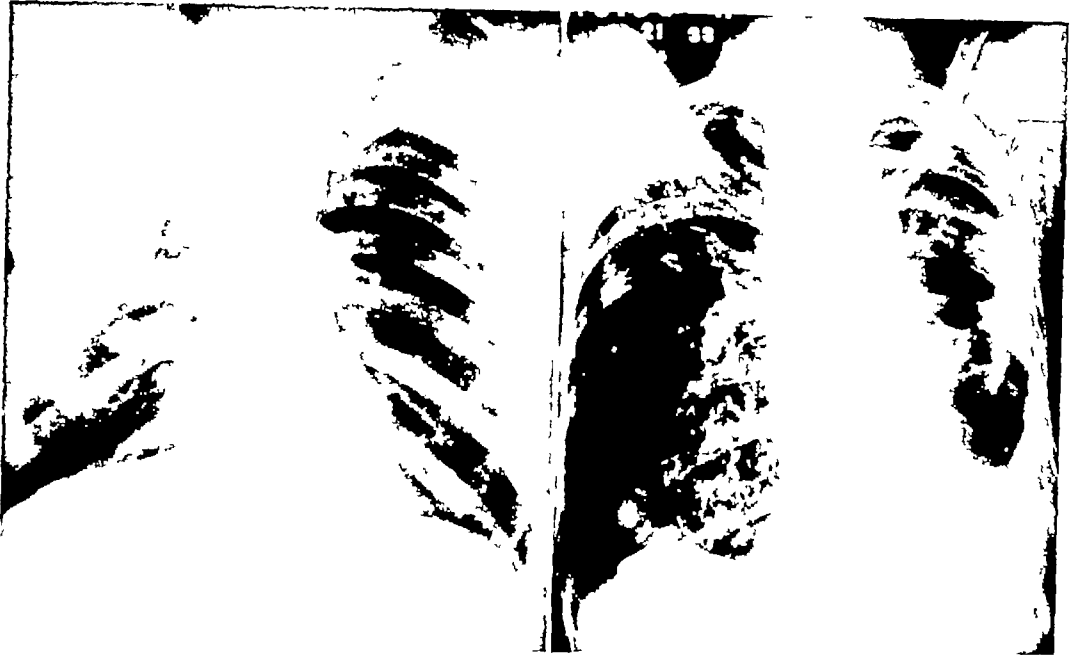


Fig 11 Following thoracoplasty the cavity closed and the sputum has been negative since

Fig 12 Bilateral disease One lung almost completely excavated The patient was too ill for active therapy Died about two months later

to receive anything but bed rest and symptomatic therapy. In the bilateral group, one-half of all cases were unfit for any other therapy. Here we find the best example of the really and truly neglected and hopeless cases. These patients also have the greatest number of extra-pulmonary complications, such as enteritis and laryngitis. Heroic treatment is often necessary and every attempt is made to close cavities. Often the patient's age makes any surgical procedure hazardous, and prolonged bed rest with symptomatic treatment offers the only way out. The column of "died from tuberculosis" is filled from this group.

It may be said in general that few occupations predispose in any way to pulmonary tuberculosis, but we find that food handlers develop a rather high incidence of the disease. We have found bakers and table waiters with far advanced disease and, with many persons in such occupations having far advanced pulmonary lesions, it is easy to understand why it is that many other patients are unaware of the source of their infection. One is safe

in assuming that many a dish served by such a person contains more than an average toleration dose of tubercle bacilli. The most common complications are enteritis and laryngitis, but as soon as the pulmonary pathology is under control and cavities are closed, these extra-pulmonary complications usually subside. Neither bone nor genito-urinary tuberculosis is common in cases with pulmonary tuberculosis. Quite a few of these patients had diabetes but it interfered very little with any treatment and they responded to therapy about as well as those who do not have diabetes.

The number of thoracoplasty cases in this series is very small, which fact does not in any way mean that few needed it, but that many of those who might have come to that stage were too ill or too old to tolerate surgery. The oldest person in this series was 83 and the youngest 13 years. The average age for all groups here listed is 32.8 years.

An interesting observation in this series is that there were nearly twice as many males as females, and this was true both

From the clinical point of view we may consider two morbid types, corresponding to two distinct stages in the course of the disease, *i e.*, the soft or congestive hypertrophy and the hard or fibrous type

The congestive type occurs at the beginning of the disease and also in some chronic cases of long standing, anatomically, it is characterized by the predominance of adenomatous formations in active development, and clinically it is expressed by the so-called premonitory functional disorders. The hard type is a fibro-adenomatous growth of late organization, generally found in a more advanced period of the disease. To the glandular hyperplasia is then added that of the connective and muscular elements, when this proliferation of the stroma chokes and eliminates the glandular acini we get the sclerotic prostate. The clinical manifestations in the stage of full development of the disease include the symptoms generally attributed to prostatic hypertrophy with or without vesical residue.

The prostatism without prostate (*prostatisme sans prostate*) is clinically the manifestation of localized hypertrophies, which at times is to be found in the group of sub-cervical glands, again in the prespermatic glands, and also in adenomas of intra-urethral development. The name is so given because, in spite of the fact that prostatism without prostate is apt to produce all the signs of hypertrophy and even the complete urinary retention, rectal examination does not show the least change in size or consistency of the prostate. The cystoscopic or posterior urethroscopic examination will plainly show the true extraprostatic pathologic condition.

To-day, science has at the specialist's disposal neat methods of investigation to facilitate an exact diagnosis. The family history, clinical history, physical examinations, the exploring catheter, cystoscope, and even the endoscope, assisted chiefly by rectal examination, will disclose not only the glandular hypertrophy from its outset but also the anatomic varieties, longitudinal modifications, deformations, and

change of direction of the deep urethra. But above all it will give exact information concerning the consistency of the hypertrophy, which is the master key to therapeutics.

If by chance the patient happens to appeal to an x-ray specialist shortly after the appearance of the premonitory disturbances, which consist of frequent nocturnal micturition, more or less marked dysuria, loss of strength, and early morning delay in initiating the flow of urine, then he will have arrived at the ideal moment for an efficient course of treatment, not only because, as we have stated before, the prostatic adenoma is in the process of evolution, but because the general health of the patient has not yet been disturbed. Unfortunately, however, we radiologists rarely see prostatic patients at this stage of the disease.

If by chance the patient should come for consultation in the fully developed stage of the disease, when disturbed by alarming symptoms, the exploring catheter reveals the presence of vesical residue coinciding with an enlarged and soft prostate, then x-ray therapy can give legitimate hope of an effective cure. The same result is also possible when the patient comes, assaulted by frequent attacks of acute retention, complete or incomplete, but without distention. However, if the patient should come for consultation, a victim of chronic retention with vesical distention, no matter what the volume and consistency of the prostate, or when the physical examination reveals the syndrome of prostatism without prostate or reveals the existence of a small sclerotic prostate, then radiotherapy is ineffective and ought to give place to surgery.

Since the time of Freyer (7 and 8), who popularized the Fuller (9) operation, in 1901, the advantages and superior technique of transvesical prostatectomy were demonstrated. This process remains in genito-urinary surgery as the ideal treatment for prostatic hypertrophy. However, its efficiency is not absolute because, even in ex-

THE PROGRESS, INDICATIONS, TECHNIC, AND SUCCESSFUL RESULTS OF RADIOTHERAPY IN PROSTATIC HYPERTROPHY¹

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A PROBLEM of so much interest as this cannot be approached scientifically without determining beforehand the true anatomic concept of the disease, since the therapeutic action of the radiations has to be controlled by the variable radiosensitivity of the various tissues which form the prostate

The investigations carried out during the last thirty years have given rise to the paradoxical doctrine that in the so-called hypertrophy of the prostate the gland itself is not hypertrophied but, on the contrary, as Motz and Pearnau (1) demonstrated in 1905, the histologic examinations revealed in the majority of the cases the existence of an inverse anatomic process, which is the atrophy of the glandular tissue. This point of view, later supported by Marquis in 1910, Cunéo in 1911 (2), Tandler and Zuckerkandl in 1911 (3), and Marion in 1912 (4), received absolute confirmation in the brilliant work of Papin and Verhac (5), directed toward the proof that, with a careful histologic study of a great number of specimens, the so-called hypertrophy of the prostate is not a genuine disease of the prostate but of the posterior urethra, since it does not originate in the prostate itself but in the hyperplasia of the peri-urethral glands, especially those of the posterior aspect of the urethra. The disorderly proliferation and the increase in size of these glands cause the true prostatic tissue to be pushed toward the periphery against the capsule, and it suffers to a greater or lesser degree in consequence of a mechanical atrophic compression.

Thus the peri-urethral extra-prostatic tumors are formed, more or less increased in size and of a varied histologic structure, according to the anatomic element upon

which the vicious tendency to abnormal multiplication falls. That is to say, in the peri-urethral gland we have, beside the true glandular tissue, formations of supportive connective tissue and muscular fibers. If the hyperplasia is developed by preference in the glandular tissue, then pure adenomas will form, which clinically present themselves as tumors of soft consistency prone to increase to a considerable size. If not only the glandular tissue but also the connective stroma participates markedly in the neoplastic development, then the result is a fibro-adenoma, which also shows a tendency to become a voluminous tumor of soft consistency, though not so much so as the one previously mentioned. When the glandular tissue is not involved or is involved to a slight degree only, allowing the connective tissue the predominance in the hypertrophic tendency, then the glandular acini are choked and there is a pure fibroma, which is clinically recognized on palpation by its woody consistency and small volume. Accordingly, whether or not the hypertrophy affects the connective tissue or only the muscular elements, we will have as a result fibromyomas, adenomyomas, or true myomas.

The classification of these anatomic varieties have great importance from the therapeutic point of view, because upon the correct diagnosis of each clinical type and the complications from each will depend the final decision as to the most logical treatment in each case.

The so-called prostatic hypertrophy is a disease very common after the age of 50, it may be stated that more than 40 per cent of persons over this age are bound to suffer from this disease, and among these 14 per cent, according to Albarran and 20 per cent according to Pauchet (6), will die as victims of a cancerous degeneration.

¹ Read by title before the American Congress of Radiology, in Chicago Sept 25-30 1933

From the clinical point of view we may consider two morbid types, corresponding to two distinct stages in the course of the disease, *i e*, the soft or congestive hypertrophy and the hard or fibrous type

The congestive type occurs at the beginning of the disease and also in some chronic cases of long standing, anatomically, it is characterized by the predominance of adenomatous formations in active development, and clinically it is expressed by the so-called premonitory functional disorders. The hard type is a fibro-adenomatous growth of late organization, generally found in a more advanced period of the disease. To the glandular hyperplasia is then added that of the connective and muscular elements, when this proliferation of the stroma chokes and eliminates the glandular acini we get the sclerotic prostate. The clinical manifestations in the stage of full development of the disease include the symptoms generally attributed to prostatic hypertrophy with or without vesical residue.

The prostatism without prostate (*prostatisme sans prostate*) is clinically the manifestation of localized hypertrophies, which at times is to be found in the group of sub-cervical glands, again in the prespermatic glands, and also in adenomas of intra-urethral development. The name is so given because, in spite of the fact that prostatism without prostate is apt to produce all the signs of hypertrophy and even the complete urinary retention, rectal examination does not show the least change in size or consistency of the prostate. The cystoscopic or posterior urethrosopic examination will plainly show the true extraprostatic pathologic condition.

To-day, science has at the specialist's disposal neat methods of investigation to facilitate an exact diagnosis. The family history, clinical history, physical examinations, the exploring catheter, cystoscope, and even the endoscope, assisted chiefly by rectal examination, will disclose not only the glandular hypertrophy from its outset but also the anatomic varieties, longitudinal modifications, deformations, and

change of direction of the deep urethra. But above all it will give exact information concerning the consistency of the hypertrophy, which is the master key to therapeutics.

If by chance the patient happens to appeal to an x-ray specialist shortly after the appearance of the premonitory disturbances, which consist of frequent nocturnal micturition, more or less marked dysuria, loss of strength, and early morning delay in initiating the flow of urine, then he will have arrived at the ideal moment for an efficient course of treatment, not only because, as we have stated before, the prostatic adenoma is in the process of evolution, but because the general health of the patient has not yet been disturbed. Unfortunately, however, we radiologists rarely see prostatic patients at this stage of the disease.

If by chance the patient should come for consultation in the fully developed stage of the disease, when disturbed by alarming symptoms, the exploring catheter reveals the presence of vesical residue coinciding with an enlarged and soft prostate, then x-ray therapy can give legitimate hope of an effective cure. The same result is also possible when the patient comes, assaulted by frequent attacks of acute retention, complete or incomplete, but without distention. However, if the patient should come for consultation, a victim of chronic retention with vesical distention, no matter what the volume and consistency of the prostate, or when the physical examination reveals the syndrome of prostatism without prostate or reveals the existence of a small sclerotic prostate, then radiotherapy is ineffective and ought to give place to surgery.

Since the time of Freyer (7 and 8), who popularized the Fuller (9) operation, in 1901, the advantages and superior technic of transvesical prostatectomy were demonstrated. This process remains in genito-urinary surgery as the ideal treatment for prostatic hypertrophy. However, its efficiency is not absolute because, even in ex-

pert hands, there is a mortality risk of more than 3 per cent

On the other hand, many patients with congestive prostates, whether or not complicated with vesical residue, but suffering from the entire group of premonitory symptoms, do not complain of attacks of retention because the habits of a peaceful and moderate life keep them out of the acute stage. In such cases, there being no real obstacle to the emission of urine, there is no reasonable cause for advising prostatectomy.

Likewise, when the presence of acute renal complications, serious troubles, or high azotemia definitely endanger the results of the surgical treatment in the classic prostatism, whether complicated or not by chronic retention with vesical distention, it is necessary for the surgeon to adopt the use of palliative methods, more conservative although less efficient. From the above and the irrefutable proofs produced long ago by radiophysiology concerning specific radiosensitivity of the adenomatous tumors, it is deduced that radiologic treatment of prostatic hypertrophy will be indicated with promise of brilliant results in cases in which surgery is not justified or where contra-indications to prostatectomy are demonstrated.

But it should be borne in mind, also, that even in cases of clearly justifiable surgery of the prostate, radiotherapy is apt to offer the same probabilities of clinical cure without anesthetic risk, post-operative complications, or confinement to bed, as long as the prostate is soft and congested.

In summary, radiotherapy is indicated

1 In cases of incipient prostatic hypertrophy, when only premonitory symptoms appear

2 In all cases of soft and congestive hypertrophy (in its residual stage), with or without acute retention accidents

3 In cases of chronic retention without distention, when these occur with voluminous adenomas or fibro-adenomas

4 As palliative treatment of chronic retention with distention, in patients with marked azotemia or with serious anatomic

or functional disturbances of the heart or kidneys

5 On the other hand, radiotherapy should be withheld in cases of sclerotic hypertrophies, in prostatism without prostate, and in malignant degeneration of adenoma, when the neoplastic production has surpassed the limits of the *Denonvillier's fascia*

More than thirty years ago the suspicion of a possible regressive action of x-ray therapy on glandular hyperplasias inspired investigators to perform a therapeutic test on benign neoplasms of the prostate. To an American, Heber Roberts (10), is due the glory of being the first to report, in 1902, three cases of congestive hypertrophy greatly improved by irradiating the gland through the perineum. At that time radiotherapy was still in its infancy. Since then its progress has been enormous, not only stimulated by the appearance of more potent and more perfect x-ray generators every year, but also determined by the discovery of the fundamental laws of radio-physics (11) and radiobiology (12), important acquisitions which favored the employment of high voltages and thick filters, indispensable for the administration of adequate doses of radiant energy in the depths of the prostatic fossa.

Roberts' attempt was not overlooked, for, three years later, Carabelli and Luraschi (13), followed later by Moskowitz and Stegmann (16), published in the medical literature of their respective countries, Italy and Austria, and transmitted to the First International Congress of Physiotherapy held in Liege, in 1905 (15 and 16), the successful result of their experiments with radiotherapy. Their results were obtained in prostatic hypertrophy in patients affected with vesical residue and retention of urine, who had a decrease in residue and disappearance of retention under the exclusive effect of the x-rays. The technique of the Italian investigators differed, however, from that of the Austrian, for while the first focussed the prostate through the perineum, Moskowitz and his

followers applied the x-ray through the rectum using a wide speculum. It is evident that this procedure, revived two years later by Schlagintweit (17) and Hoenish (18), would soon be out of use, not only because of discomfort to the patient but also because it would not allow a uniform radiation of the tumor, since no matter what the position of the patient might be, the incidence of the x-ray beam was oblique and tangential to the posterior surface of the prostate. However, Carabelli and Luraschi's technic, following the route outlined by Robarts, by choosing the perineal region, opened the way to a reasonable and promising route for attacking the prostatic adenoma with greater efficiency. The method consisted in applying at a skin-anode distance of from 20 to 25 centimeters one-third to one-half of an erythema dose two or three times a week, at first, and every 15 days later, up to a total of 15 applications, using rays of a hardness of 6 or 7 Benoist. That this procedure was worthy of imitation was later demonstrated by the experiments of Tansard and Fleig (19), of Hunter (20), and of others.

While these investigators operated by irradiating the prostate directly, Wilms and Postner, in 1911 (21), and O. Ehrmann, encouraged by the regressive effect which the irradiation of the ovaries produced on uterine fibromas, thought it logical to expect, from separate irradiation of the testicles, a similar result on the prostate, and, therefore, preached this procedure of indirect radiotherapy which was strongly and justly criticized by Zindle as inefficient and unnecessary.

Since 1906, the experiments of Freund and Sachs (22) on prostates of dogs had proved that strong x-ray doses, even of the slight penetration available at that time, determined the sclerosis of the gland and in consequence reduced its volume. However, it was not until 1913 that the interesting paper read by Haret (23) before the Congress of Medicine in London, presented a practical method which showed evident progress over previous experiments.

Shortly afterward Tousey (24), in 1915,

reported his partial success from irradiating the prostate every two days through the perineal region with rays of 7 Benoist filtered through sole leather, up to an erythema dose or 5 H units.

In 1920, Albert Weil described in his Treatise of Radiology (25) a perfected and more efficient technic than the former ones, with the application of rays of more potent penetrability (120 K V) filtered through 10 millimeters of aluminum and directed at the prostate in cross-fire from two portals of entry, one anterior, supra-pubic, and the other posterior, perineal. The testicles were not protected and, in order to reach in depth a greater dose through the perineal field, the patient was laid on his abdomen, the buttocks being raised with a cushion. Through each of these fields Weil administered from 10 to 12 H with 20 centimeters anode-skin distance. These applications were repeated monthly for four or five months.

Two years later Nogier (26 and 27), in order to improve and modify his technic for attacking the tumor only through the perineal region, had a special chair known in France as *Nogier's horse*, on which the patient sat astride to receive the treatment from a tube placed underneath. He employed weaker rays (100 K V) than did Weil, with less efficient filtration, since this did not exceed 4 millimeters aluminum. Nevertheless, Nogier assures us that in the prostatic congestion at the beginning of the disease a cure can be effected in four weeks, applying weekly a little over one-third of an erythema dose, and that in glandular hypertrophy improvement usually takes place during the sixth week.

In the following year, 1923, Haret (28) and his pupil Devois (29) changed their initial technic, raising the voltage to 120 K V and administering 275 r units, through the perineum each week for ten consecutive weeks, up to a total of two erythema doses. These doses were higher than those he gave at first and those advised by Nogier and Weil, but the technic was defective in that it employed filters of only 5 millimeters of aluminum, not

thick enough to irradiate efficiently, and without injuring the skin, organs situated at a depth of from 7 to 8 centimeters

A year later Ledoux-Lebard (30) gave a formidable impulse to radiotherapy of prostatic hypertrophy by abandoning the medium tensions and applying the principles of deep therapy. In order to insure a uniform radiation of the prostatic fossa, he used two portals of entry, one suprapubic and the other perineal, and through each one of these he gave fractional doses during a month, totaling 1,200 international r units at 200 K V, filtering through a millimeter of copper

Wetterer (31), although advocating the exclusive radiation through the perineum, also uses very penetrating rays (200 K V) and thick filters, administering strong doses (15 H) at a sitting, but giving treatments every three or four weeks

Holfelder (32), inspired by Nogier's method, attacks the prostate through the perineum, irradiating it from the bottom up with ultra-penetrating and well filtered rays. For this he uses a cylinder of his own invention, electric shockproof and impermeable to x-rays. This cylinder has an opening where the various cones and filters can be inserted and through which passes the beam of x-rays coming from the anticathode of a tube inside the cylinder. This, moreover, has up-and-down, rotary, and inclined movements adaptable to every conceivable position. The patient must sit, resting the perineum on the radiation cone, so that the body weight compressing the perineum will reduce the distance from the skin to the prostate to a minimum of 6 centimeters. Thanks to this apparatus, Holfelder obtains a dose sufficient in depth to produce, without the slightest injury to the skin, the regression of the hypertrophied gland. This appliance is very comfortable, but has the disadvantage of being high-priced, therefore, its use is limited to large institutions

Iser Solomon's (33) technic is similar to that of Haret, utilizing the perineal field through which he gives, in 10 or 12 applications, a total dose of from 2,500 to 3,000

r international units of rays at 200,000 volts, filtered through 0.5 mm of copper plus 1 mm of aluminum. He admits that he has obtained good results in soft hypertrophies

In 1927, Vignal (34 and 35) recommended exclusive radiation through the perineum, placing the patient in a lateral position with the thigh flexed on the abdomen and the leg on the thigh. However, this position does not permit a uniform radiation to the prostatic fossa. He used two methods, one for apparatus with an average penetration of 120 K V, filtering through 6 mm of aluminum, and another for deep therapy apparatus using from 150 to 200 K V. In both cases he gave fractional weekly treatments of 180 to 360 r up to a total of from 2,275 to 2,725 r

Pierre Lehmann, in 1932 (36 and 37), revived Weil's technic with respect to the selection of the portals of entry and the position of the patient on the table, but he employed tensions of 200 K V and filters through 0.8 mm of copper plus 2 mm of aluminum, increasing the focus-skin distance to 45 centimeters. He administers a total dose of 1,800 r through the suprapubic field, divided in four doses of 450, and through the perineum 1,400 r, distributed in four doses of 350 r. The treatments are repeated every two days until the completion of the series

Secondary only to the work of Ledoux-Lebard and his followers, this work of Lehmann represents one of the most valuable contributions to non-surgical treatment of prostatic hypertrophy. However, it should be noticed that, except for his heavier doses, his technic differs very little from that of Ledoux-Lebard

Ever since 1920, the author has applied radiotherapy to selected cases of prostatic disease. As at that time our equipment did not allow the use of voltage higher than 100 K V, we had to operate under conditions limited by filtration and distance. The factors we used were as follows: K V 100, focus-skin distance, 25 cm, filter, 4 mm aluminum, a 10 cm circular portal of entry for the perineum,

position of patient, gynecologic semi-Trendelenburg, milliamperage 3 to 5 ma through a standard large focus Coolidge tube, time, 5 minutes, dose 0.5 to 1 H unit. The treatments were repeated every two days to a total of 10 units H, measured with the Corbett's radiometer. With this procedure, though the result was favorable, especially when we attempted to deal with pre-hypertrophic congestive phenomena, we nevertheless did not obtain cures of long duration except in one of the four cases observed. But, in 1922, we installed a deep therapy equipment of 280 K V, and we immediately changed to a technic similar to Weil's, but improving the tension, filter, and distance factors, which we substituted, respectively, for 150 K V, 0.5 mm of copper plus 1 mm of aluminum in addition to 1 mm of celluloid and 50 cm skin-anticathode distance. In 1924, we adopted the Ledoux-Lebard method as regards kilovoltage, filtration, and dosage, but still kept Weil's position for the patient.

From that time up to date our technic has changed little, the constant factors being as follows: voltage, 180 to 200 K V, filter, 1 mm copper plus 1 mm aluminum, distance, 50 cm, tube, high voltage Coolidge water-cooled and 25 milliamperes per minute. According to Lehmann and Albert Weil's method, we irradiate through two fields, one suprapubic and the other perineal, but rectangular, and of 12×15 cm, administering through each a total dose of 1,500 r, divided in five fractional treatments of 300 r. At each sitting we irradiate only one field and repeat the treatment every two days, alternating the suprapubic with the perineal field. In this way, 18 days are required for a complete series. As the prostate lies from 8 to 10 cm from the pubic and some 7 to 8 cm from the perineum, it will absorb more than half of the 3,000 r administered to the skin, a deep dose sufficiently active even in case of incipient malignant degeneration.

It is very important to be sure beforehand of the true location of the prostatic urethra, datum best obtained by rectal

palpation with the patient lying on the treatment table in the same position in which x-rays are to be applied, since only in this manner is it possible to find the most convenient direction of the x-ray beam and, with approximate exactness, the distance from the organ to the skin of the pubis and the perineum. We employ a seasoned wooden localizer covered inside by a thick lead shield, with an opening of 12×15 cm, for the irradiation of the suprapubic field. This localizer, if possible, must be held pressed firmly against the abdominal wall until its inferior edge comes in contact with the pubis. To irradiate the perineal field we place the patient, as does Weil, on his abdomen with the thighs well separated, raising the buttocks as high as possible by means of cushions, until the perineum can be well seen and then, with the same localizer, we direct the x-ray beam toward the tip of the coccyx in a straight line to the symphysis pubis.

The undesirable accidents with this method generally occur only with exaggerated doses or when the interval between two sittings is not in accordance with the variable susceptibility of the individuals or with the stage of the disease. They consist of a more or less intense exacerbation of the pollakiuria and the dysuria, as well as of signs of rectal irritation, such as frequent desire to move the bowels with painful tenesmus and whitish or mucosanguineous evacuations. But these inconveniences may be avoided or corrected by lowering the dosage at each sitting or extending to more than two days the interval between them. As a last resort, the treatment should be stopped for a short while.

When everything goes well, the first symptom to improve is the frequent nocturnal micturition, which from the first treatment decreases to the normal. Then comes the improvement of the dysuria and an increase in the strength and caliber of the flow, followed by the disappearance of the morning delay in initiating micturition. In those cases of retention with

scant residue, this may even disappear, but if it exceeds the amount of 200 c c we can only expect a decrease. The size of the prostate is that which takes longest to modify, depending on the nature of the hyperplasias for the rapidity of its regression. When this is purely glandular, it decreases rapidly, but if the connective tissue is predominant, then regression will be late or *nil*. It should be noted, however, that a positive and marked improvement, with disappearance of the urinary disturbances, heavy sensation in the perineum, and decrease in size of the prostatic adenoma, cannot be expected before three months after the completion of treatment. If after this lapse of time, the improvement, though marked, does not continue, it would be advisable to repeat the series under the same conditions. However, if on the contrary, the symptoms are not modified, then it is time to give place to surgery.

Beside the contra-indications enumerated, roentgen therapy should not be advised when there exists severe infection of the hypertrophied gland, although Wetterer recommends it as the ideal treatment for gonococcal prostatitis. Irradiation should not be employed for prostatic adenomas complicated with vesical calculi, urethral strictures, or intraprostatic calculi. On the other hand, in hypertrophies complicated with hematuria due to prostaticovesical congestion, radiotherapy constitutes one of the best treatments.

The author has treated only twelve cases, which may be grouped thus: four with roentgen therapy of medium voltage (100 K V) and filtration through 4 mm of aluminum, three with semi-penetrating rays (150 K V) and filtration of 0.5 mm of copper, and five with deep therapy, according to the above technique. From the first group only one patient, 55 years old, in the first stage of his disease, complaining only of premonitory symptoms without vesical residue and in whom a rectal examination had disclosed a soft prostate of double the normal size, had a permanent disappearance of the urinary disturbances.

To-day, 12 years afterward, he seems to be in good health. From the second group, one patient with incomplete retention and vesical residue of over 400 c c had no improvement and it was necessary to recommend a prostatectomy, which was performed by a Baltimore specialist. The other two were of the soft, voluminous type of hypertrophy, without retention or residue, both improved notably and their urinary disturbances disappeared completely. Among the third group there was a man, 80 years of age, who had a vesical residue of over 300 c c and a large infected prostate. This patient was treated only palliatively since he refused surgical intervention. He had a disappearance of hematuria, a decrease in the residue to 150 c c, and an improvement in the pollakiuria and dysuria. His urine, however, remained cloudy and his prostate about the same size, up to the time of his death, which was due to an intercurrent illness. The other four, all cases of soft glandular hypertrophy without attacks of retention, have not been annoyed further by the common symptoms of prostatism.

These results, which are only a confirmation of those obtained with deep therapy by other specialists of Europe and America, authorize us to sustain that, in view of the recent progress in roentgen therapy, it represents the ideal treatment for the so-called hypertrophy of the prostate in its first stage, and that it is, besides, an excellent treatment in the more advanced stages, provided that they are not of the sclerotic type, and that no serious complications exist.

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The author has treated only twelve cases, which may be grouped thus: four with roentgen therapy of medium voltage (100 K V) and filtration through 4 mm of aluminum, three with semi-penetrating rays (150 K V) and filtration of 0.5 mm of copper, and five with deep therapy, according to the above technique. From the first group only one patient, 55 years old, in the first stage of his disease, complaining only of premonitory symptoms without vesical residue and in whom a rectal examination had disclosed a soft prostate of double the normal size, had a permanent disappearance of the urinary disturbances.

To-day, 12 years afterward, he seems to be in good health. From the second group, one patient with incomplete retention and vesical residue of over 400 c c had no improvement and it was necessary to recommend a prostatectomy, which was performed by a Baltimore specialist. The other two were of the soft, voluminous type of hypertrophy, without retention or residue, both improved notably and their urinary disturbances disappeared completely. Among the third group there was a man, 80 years of age, who had a vesical residue of over 300 c c and a large infected prostate. This patient was treated only palliatively since he refused surgical intervention. He had a disappearance of hematuria, a decrease in the residue to 150 c c, and an improvement in the pollakiuria and dysuria. His urine, however, remained cloudy and his prostate about the same size, up to the time of his death, which was due to an intercurrent illness. The other four, all cases of soft glandular hypertrophy without attacks of retention, have not been annoyed further by the common symptoms of prostatism.

These results, which are only a confirmation of those obtained with deep therapy by other specialists of Europe and America, authorize us to sustain that, in view of the recent progress in roentgen therapy, it represents the ideal treatment for the so-called hypertrophy of the prostate in its first stage, and that it is, besides, an excellent treatment in the more advanced stages, provided that they are not of the sclerotic type, and that no serious complications exist.

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were then made every 15 minutes, until the food column had reached the cecum, and continued until the stomach and small intestine had emptied. The colon observations were made at longer intervals of time because of the slow emptying of this organ. Careful records were made of all our observations, which demonstrated the normal motility of the gastro-intestinal tract of these 27 normal rats. They were then divided into four separate groups and roentgenographic examinations were made of representative rats of each group. In the first group, six of the 27 normal rats previously examined were used. They

were fed a deficient vitamin D diet until all showed definite rachitic bone changes as revealed by the x-ray, their gastro-intestinal tracts were studied by means of the fluoroscope. All showed a marked hypomotility. These six rats were then given a normal diet until their bone changes were healed, after which time they were again fluoroscoped to ascertain whether or not the hypomotility previously found was in any way altered. These rats were continued on a normal diet for several months and again fluoroscoped as in the previous examinations. The hypomotility

GROUP 1 —NORMAL RATS MADE RACHITIC THEIR BONE CHANGES HEALED WITH A NORMAL DIET

Date	Wt	Ate	Cecum	St	Sm in emt	Col	No rats	Kind
			App time emt					
5/10/31	95 6	6 4	2 40	7 10	9 28	69	6	Normal
6/14/31	104 3	7 3	2 08	8 27	10 24	79	6	Rachitic
7/3/31	107 0	7 6	3 01	10 13	12 06	87 8	6	Healed
10/18/31	198 0	9 2	3 33	7 27	11 36	79 2	5	Healed (3 1/2 mo)

GROUP 2 —NORMAL RATS MADE RACHITIC THEIR BONE CHANGES HEALED WITH VIOSTEROL

Date	Wt	Ate	Cecum	St	Sm in emt	Col	No rats	Kind
			App time emt					
5/10/31	89	4 4	2 46	6 32	9 11	63	6	Normal
6/14/31	95 6	7	2 10	8 06	10 16	79	6	Rachitic
7/3/31	86 3	8 6	2 43	9 47	11 45	89	6	Healed (viosterol)
10/18/31	195 0	9 3	3 22	7 45	11 02	80 8	6	Healed (3 1/2 mo)

GROUP 3 —NORMAL RATS MADE RACHITIC THEIR BONE LESIONS HEALED BY ULTRA-VIOLET RAY

Date	Wt	Ate	Cecum	St	Sm in emt.	Col	No rats	Kind
			App time emt					
5/10/31	88 3	6 4	3 07	6 47	9 30	65	6	Normal
6/14/31	102 5	6 8	2 33	8 36	11 07	79	6	Rachitic
7/3/31	136 0	8 8	2 50	9 55	11 31	80	6	Healed (vosterol)
10/18/31	244 8	9 3	2 51	9 20	11 28	81	6	Healed (3 1/2 mo)

GROUP 4 —NORMAL RATS MADE RACHITIC AND CONTINUED ON A RACHITIC DIET FOR MONTHS

Date	Wt	Ate	Cecum	St.	Sm in emt	Col	No rats	Kind
			App time emt					
5/10/31	102 8	7 1	2 42	6 20	9 08	61	9	Normal
6/14/31	121 7	7 2	2 12	8 26	10 32	79	9	Rachitic
10/18/31	144 1	8 4	3 53	9 35	12 13	89	5	(kept on rachitic diet)

X-RAY EXPERIMENTAL STUDIES SHOWING THAT RACHITIC RATS WITH HEALED BONE LESIONS CONTINUE TO SHOW ALTERATION IN THEIR GASTRO-INTESTINAL TRACT¹

By L J MENVILLE, M D, J N ANÉ, M D, and S N BLACKBERG, Ph D, *New Orleans*

Department of Medicine, Tulane University, and Department of Pharmacology, Columbia University

IN ORDER that experimental observations upon animals may have a practical application to man, it is necessary to utilize animals whose diet is very much of the same nature as that of the human species, and whose gastro-intestinal tracts bear a close resemblance to those of primates. In the rat, we have an animal that will ideally serve this purpose, better, in fact, than herbivorous or graminivorous mammals, and the results obtained in young rats should be comparable with those of infants and young children.

In a previous experimental study (1) on the motility of the gastro-intestinal tract of rachitic rats, we reported that in every instance they showed a marked hypomotility when compared with normal rats. As a result of our experiments with rats, it was concluded that the constipation so frequently observed in rachitic children was perhaps the outcome of an altered motility of their gastro-intestinal tracts.

Authorities on pediatrics recognize constipation as a frequent early symptom of rickets and is said by them to become more marked in the later stages of the disease. This symptom of rickets is perhaps the result of muscular weakness and relaxation of the gastro-intestinal tract, and if these changes are not corrected early, it is possible that they will continue long after the patient is considered to be cured of rickets. This is especially important because it is generally believed that infants and children are considered to be cured of rickets when their bone lesions have been proven definitely healed as shown with the x-ray.

In order to ascertain whether or not the

healing of rachitic bone lesions in rats would be the cause of relieving them of their constipation, we undertook an experimental investigation in the early part of 1931. The results of this study made on three rachitic rats, with their bone lesions healed by means of viosterol, showed that the hypomotility of their gastro-intestinal tracts remained unaffected. We presented our observations to the Southern Branch of the Society for Experimental Biology and Medicine, in June, 1931 (2).

Realizing that three rats were too small a number from which to draw any definite conclusions as to the results obtained in these experiments, we undertook another similar experimental study, using a larger number of rats and employing several methods of healing the rachitic bone changes, continuing our fluoroscopic observations over a period of months.

In the experiments herein reported, 27 young normal rats were used, each being marked so that correct identification would be possible even months after they had been branded. All of the rats were made to fast for 48 hours, water being withheld during the last 24 hours of fasting. Placed in separate cages they were then fed a carefully weighed meal which consisted of three parts of buttermilk and one part of barium sulphate (making a 10-gram mixture) they were allowed to eat for 20 minutes. The amount of food that was left by each rat was then carefully weighed. In this manner, we were able to keep an accurate record of the amount of food eaten by each one. They were then placed in individual loose cotton bags, as previously described (3), and fluoroscoped to ascertain whether or not their stomachs were filled. Fluoroscopic observations

¹ Read before the Radiological Society of North America, Dec. 3, 1931

ROENTGEN PELVIMETRY AND FETAL CEPHALOMETRY A NEW TECHNIC¹

PRELIMINARY REPORT

By ROBERT P BALL, M D , and S S MARCHBANKS, M D , *Chattanooga, Tennessee*

IN THE effort to increase the accuracy of obstetrical examination, especially in marginal size cases in which the need for increased accuracy may be vital, we are using the technic described herein. The technics developed and advocated by others, while satisfactory in their own hands, do involve the use of special

of a series of these teleoroentgenograms suggested the value and importance of the visualization of labor, accurate mensuration, the construction of a passenger-passage ratio, and the establishment of a normal fetal increment of increase.

Accordingly we present this simplified technic of pelvimetry and fetal cephalom-

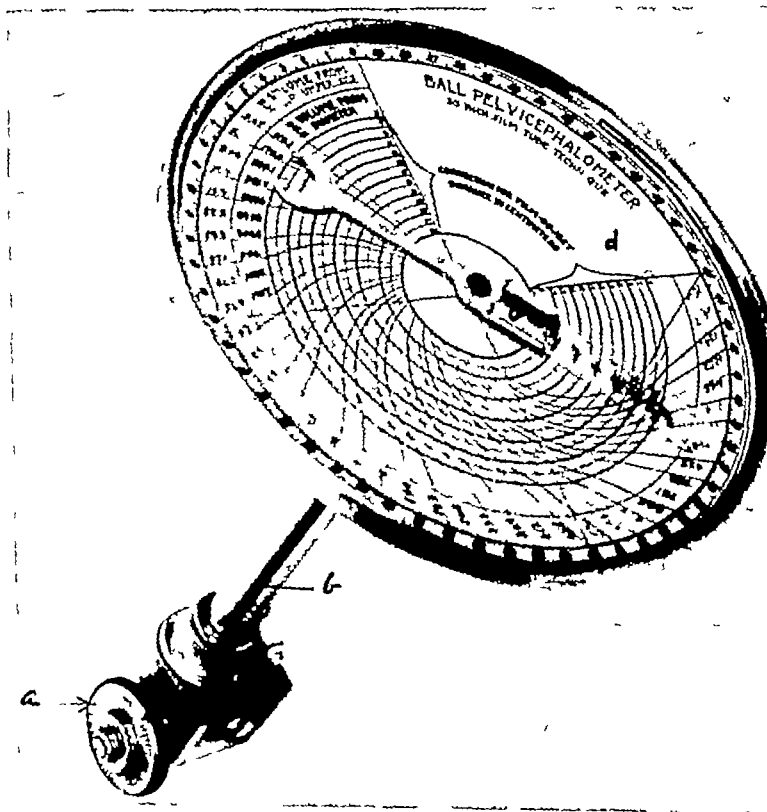


Fig 1 The pelvicephalometer

film markers, the personal equation of the examiner, and rather wide variation in results. Of these methods advocated, we obtained the most information by the use of teleoroentgenograms (S S M). A study

It embodies the use of a circular chart, placed upon the dial of an instrument which corrects for the size of the fetal head and object-film distance. The fetal skull is measured by tracing the instrument around the circumference of the skull on the roentgenogram, and from the chart a corrected circumference measure-

¹ Presented before the Radiological Society of North America, at the Twentieth Annual Meeting, in Memphis, Tenn., Dec 3-7 1934.

found at previous examinations was still evident, and did not return to normal

In Group 2, six of the remaining 21 normal rats were used and after being made rachitic, as in Group 1, they were fluoroscoped. All the rats of this group showed a marked hypomotility. Their bone lesions were then healed by means of viosterol, and their gastro-intestinal tracts were again fluoroscoped, however, the hypomotility of their gastro-intestinal tracts still persisted. They were then given a normal diet for several months and their gastro-intestinal tracts were re-examined, the hypomotility previously found being still evident.

Group 3, which included six of the remaining 15 normal rats, made rachitic, was examined in the same manner as in Groups 1 and 2. All of them showed a marked hypomotility of their gastro-intestinal tracts. Their bone changes were healed by means of the ultra-violet ray and again fluoroscoped when it was found that the hypomotility previously found remained evident. They were then given a normal diet for several months and again examined, when their hypomotility was found as in the previous examinations.

Group 4 consisted of the remaining nine normal rats which were made rachitic. They were examined and then kept on a rachitic diet for several months, at which time they were re-examined, when their hypomotility previously found was not affected. During the several months of observations their epiphyses united with the shaft, and the characteristic rachitic

bone changes were no longer evident. Their hypomotility persisted during this prolonged rachitic diet in spite of the disappearance of their rachitic bone changes.

CONCLUSIONS

These experiments definitely demonstrate that young rats, made rachitic, show a marked hypomotility of their gastro-intestinal tracts, and the healing of their rachitic bone changes by the different means employed do not relieve them of their hypomotility even after a period of months when the bones have healed.

If the life cycle of these rats is compared with that of humans, it must be concluded that if the cause of constipation in rachitic rats is due to muscular weakness and relaxation of their gastro-intestinal tracts, as evidenced by a hypomotility, then rachitic patients, who have had their bone lesions healed by the various methods employed at the present time, are apt to continue to show alterations in the motility of their gastro-intestinal tracts for a long time after they are considered cured of rickets.

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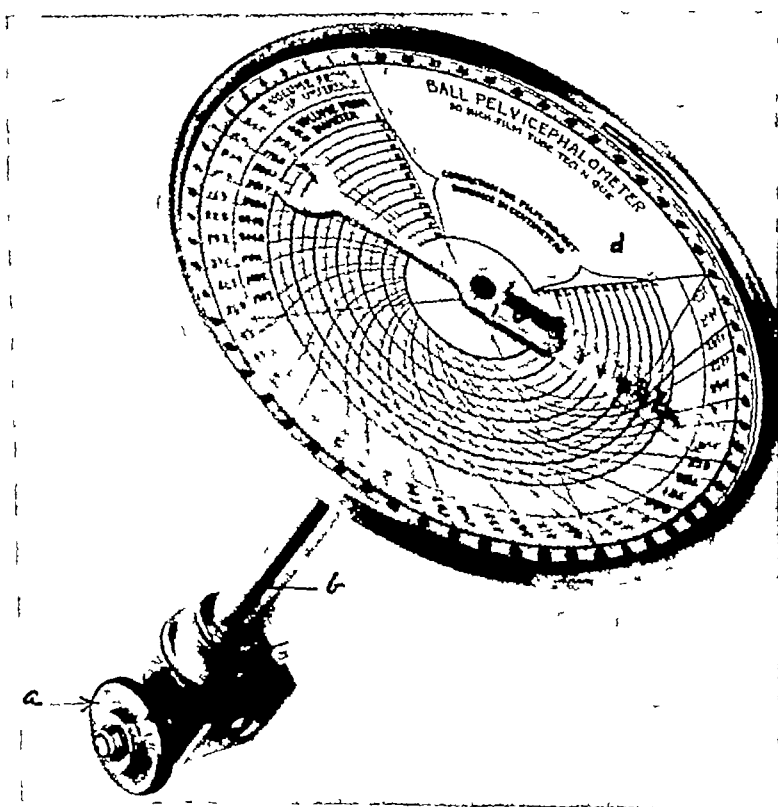


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ment in centimeters is read directly This is translated into terms of volume in milliliters The pelvic measurements determine a measure of the size of the fetus than are diameters The percentage of error in the reading is reduced in more ways than

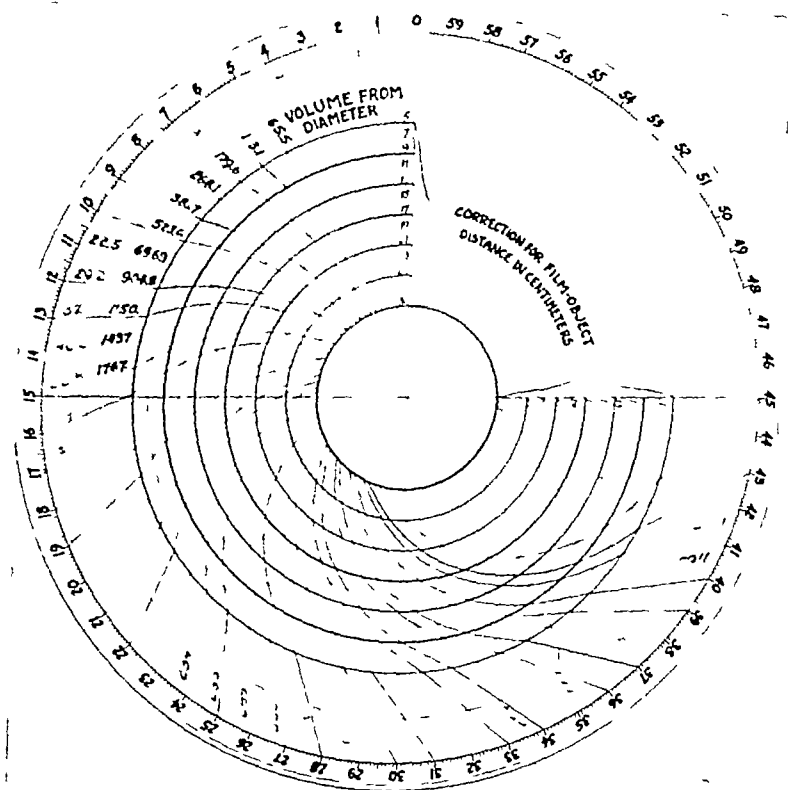


Fig 2 A chart used as a dial on the instrument to correct the size of the object and film object distance

mined are the anteroposterior diameter (true conjugate) and the ischial interspinous diameter in centimeters, and are translated into terms of volume capacity of a sphere of this diameter A description of the chart and technic employed, with results, is presented

For practical purposes, the fetal head and maternal pelvis must be measurable in relative terms In the past, it has been customary to compare the diameters of the fetal head with the diameters of the pelvis of the mother By this means the size of the fetal head was compared with diameter measurements of the pelvis

However, it has been found that the mean circumference of the fetal head is always obtainable from the anteroposterior and lateral views and is a more depend-

one To begin with, it makes no difference how obliquely the head is presented and hereby a larger percentage of films is readable The units of measure are increased by more than three times the diameter units In estimating the body weight of a fetus, the mean circumference has been reliable to within one-half pound in over 85 per cent of the cases and to within one pound in the remaining 15 per cent

The following technic, chart, instrument, etc., were conceived and designed by one of us (R. P. B.) and will be presented as they are used in an examination

TECHNIC OF EXPOSURE

A film of the pelvis and lower abdomen in anteroposterior view is taken with the

patient in the supine position. The patient is placed in the center of the table over a Potter-Bucky diaphragm and the

breech presentation it may be necessary to center the tube and film higher for additional films

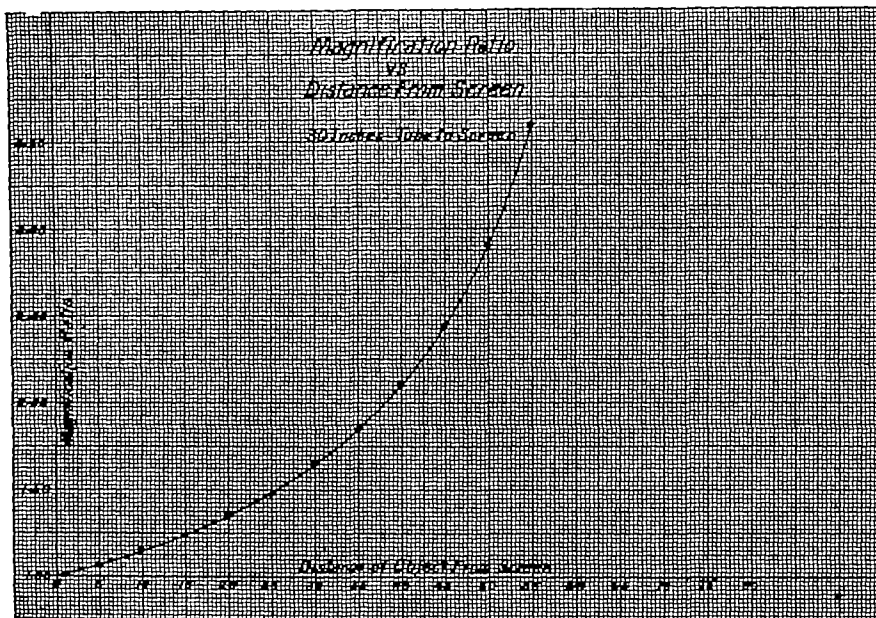


Fig 3 A chart showing the magnification ratio of linear measurements of objects at varying distances from the film. The target-film distance was 30 inches or 76.2 centimeters. Figures on ordinate represent factor of magnification.

tube is centered over a point midway between the antero-inferior iliac spines. Only a right or left marker is used. A tube-film distance of 30 inches is our routine. The energy required in this view will average 84 K V P, 30 ma for 4 seconds. A lateral view is then taken by placing the patient in the center of the table and centering the tube over the inferior margin of the anterosuperior iliac spine. The patient is more easily placed in correct position on a curved table top. For the ateral view, a pillow is placed between the knees—it aids materially in preventing movement and is more comfortable. A separation of knees, in the lateral position, maintains the true conjugate diameter of the pelvis on the same plane. The exposure for the lateral view will average 84 K V P, 30 ma, 12 seconds.

There are no measurements taken of the patient or any markers placed on her. Films of the 14 × 17 inch size are used and the long diameter is placed transversely to the pelvis. In multiple pregnancy and

THE "PELVICPHOLOMETER"

An instrument, the pelvicepholometer (Fig 1), is used to measure the circumference of the fetal head and diameters of the maternal pelvis. This was constructed to more conveniently utilize a chart (Fig 2) designed to correct linear and volumetric magnification. It consists of a small wheel (Fig 1a), mounted on a shaft which by a worm gear mechanism turns a second shaft (b) upon which a pointer is mounted. The pointer (c) travels above the surface of a dial (d) upon which the chart is fastened. The small wheel (a) is run over the periphery of the object to be measured. The ratio between the wheel (a) and the second shaft is such that a pointer, of proper length for the chart, will travel over the same distance as the wheel (a).

The chart shows the figures at the periphery in centimeters. In the 360 degrees of this circular chart there are 60 divisions, representing 60 centimeters linear travel of

the wheel (a) Millimeter divisions are also shown (Fig 1) The row of figures subjacent to the centimeter scale show the volume of a sphere, in milliliters, with a circumference of the corresponding measurement in centimeters The third row of figures shows the volume of a sphere with a diameter measurement of the centimeter to which it is subjacent (Fig 2)

The curved lines extending from the centimeter divisions to the center require some explanation The linear magnification of an object as registered on the film will vary with the distance of the object from the film When the tube-film distance is known this magnification can be calculated by various methods It may be determined by geometry or by the use of a calculated scale such as Walton has used The important data are the factors of linear magnification of different sized objects at different distances from the film Table III shows the factor of linear magnification This table was constructed in

a manner similar to that used by Walton in the construction of his false centimeter scale, and compared with a geometrical calculation The radial lines in the chart represent the plotting of polar co-ordinates A plotting on a rectangular chart is shown in Figure 4 The mathematical formula will be reported in a later communication The pointer (c) on the dial is a scale on transparent material A line in the center is used for a straight edge and extends to the periphery of the chart This scale represents the distance, in centimeters, of the object from the film when exposure is made

READING THE FILM

Both dry films are placed on a view box and are interpreted as to the position of the fetus, presentation, engagement into the superior strait, fetal or maternal abnormalities of skeletal structures, etc The circumference of the fetal skull (cranial) is then traced with the pelvi-

TABLE I—VOLUME AND DIAMETER OF SPHERE-CIRCUMFERENCE GIVEN

Circumference	Volume	Diameter	Circumference	Volume	Diameter
15 cm	56 8 cc.	4 77 cm	33 cm	606 0 cc	10 50 cm.
15 5 cm	62 8 cc	4 93 cm	33 5 cm	636 0 cc	10 67 cm.
16 cm	69 0 cc.	5 09 cm	34 cm	662 0 cc	10 82 cm
16 5 cm	75 7 cc	5 25 cm	34 5 cm	693 0 cc	10 98 cm
17 cm	83 0 cc	5 41 cm	35 cm	721 0 cc.	11 13 cm.
17 5 cm	90 5 cc	5 57 cm	35 5 cm	755 0 cc	11 30 cm.
18 cm	98 0 cc	5 72 cm	36 cm	788 0 cc.	11 46 cm
18 5 cm	106 5 cc	5 88 cm	36 5 cm	820 0 cc.	11 62 cm
19 cm	115 4 cc	6 04 cm	37 cm	855 0 cc	11 78 cm
19 5 cm	125 0 cc	6 20 cm	37 5 cm	889 0 cc.	11 93 cm.
20 cm	135 0 cc	6 36 cm	38 cm	924 0 cc.	12 09 cm
20 5 cm	145 1 cc	6 52 cm	38 5 cm	961 0 cc	12 25 cm
21 cm	156 4 cc	6 68 cm	39 cm	1002 0 cc	12 42 cm
21 5 cm	168 0 cc.	6 84 cm	39 5 cm	1042 0 cc	12 58 cm.
22 cm	180 0 cc.	7 00 cm	40 cm	1080 0 cc	12 73 cm
22 5 cm	192 2 cc	7 16 cm	40 5 cm	1122 0 cc	12 89 cm
23 cm	205 8 cc	7 32 cm	41 cm	1165 0 cc.	13 05 cm.
23 5 cm	218 0 cc.	7 47 cm	41 5 cm	1204 0 cc	13 20 cm
24 cm	233 5 cc	7 64 cm	42 cm	1252 0 cc.	13 37 cm.
24 5 cm	248 5 cc	7 80 cm	42 5 cm	1293 0 cc.	13 52 cm
25 cm	263 0 cc.	7 95 cm	43 cm	1342 0 cc.	13 68 cm
25 5 cm	280 0 cc	8 12 cm	43 5 cm	1390 0 cc	13 84 cm
26 cm	296 0 cc.	8 27 cm	44 cm	1437 0 cc	14 00 cm
26 5 cm	314 0 cc	8 14 cm	44 5 cm	1487 0 cc.	14 16 cm
27 cm	333 0 cc.	8 60 cm	45 cm	1531 0 cc.	14 30 cm
27 5 cm	350 0 cc.	8 75 cm	45 5 cm	1588 0 cc	14 47 cm
28 cm	369 0 cc.	8 90 cm	46 cm	1640 0 cc	14 63 cm
28 5 cm	389 0 cc.	9 06 cm	46 5 cm	1692 0 cc.	14 79 cm
29 cm	412 0 cc	9 23 cm	47 cm	1746 0 cc	14 94 cm
29 5 cm	433 0 cc	9 39 cm	47 5 cm	1803 0 cc.	15 10 cm
30 cm	455 0 cc.	9 54 cm	48 cm	1867 0 cc.	15 27 cm
30 5 cm	478 0 cc.	9 70 cm	48 5 cm	1922 0 cc	15 43 cm
31 cm	502 0 cc	9 85 cm	49 cm.	1982 0 cc	15 59 cm
31 5 cm	524 0 cc.	10 01 cm	49 5 cm	2044 0 cc	15 75 cm.
32 cm	552 0 cc.	10 18 cm	50 cm	2105 0 cc	15 90 cm
32 5 cm	578 0 cc	10 34 cm.			

TABLE II—VOLUME OF SPHERE-DIAMETER GIVEN

Diameter	Volume
5 cm	65 45 cc.
5 5 cm	87 11 cc.
6 cm	113 10 cc.
6 5 cm	143 79 cc.
7 cm	179 59 cc.
7 5 cm	220 89 cc.
8 cm	268 08 cc.
8 5 cm	321 56 cc.
9 cm	381 70 cc.
9 5 cm	448 92 cc.
10 cm	523 60 cc.
10 5 cm	606 13 cc.
11 cm	696 91 cc.
11 5 cm	796 33 cc.
12 cm	904 78 cc.
12 5 cm	1022 70 cc.
13 cm	1150 3 cc.
13 5 cm	1288 2 cc.
14 cm	1436 8 cc.
14 5 cm	1596 3 cc.
15 cm	1767 1 cc.

cepholometer on the film (for the sake of description) in the anteroposterior view, with the line on the pointer placed over zero on the chart at the beginning of the tracing. After completing the tracing of the circumference on the film, the spot at which the pointer rests is noted. This is the magnified circumference on the film in true centimeters. With any centimeter scale the distance of the fetal skull from the film in the anteroposterior view is determined by measuring on the film taken in the lateral view the distance from the mid-portion of the skull to the posterior border of the sacrum. To this measurement is added the distance from the table top to the film. This will represent in centimeters the approximate distance of the fetal head from the film in the anteroposterior view. In the average patient the soft tissue between sacrum and table top is about the linear magnification of the fetal head-film distance, using a 30-inch target-film technic. The corrected reading for the circumference is then made by shifting the dial or retracing pointer to the point where the subjacent radial curve is intersected by the figure on the pointer which indicates the approximate object-film distance. At the periphery of the chart, the straight line on the pointer will then be resting over the corrected read-

TABLE III—FACTOR OF MAGNIFICATION OF LINEAR DIMENSIONS ON FILM, WITH OBJECT AT VARIOUS DISTANCES FROM FILM TARGET-FILM DISTANCE, 30 INCHES OR 76.2 CENTIMETERS

Object-film Distance	Factor of Magnification	Object-film Distance	Factor of Magnification
5 cm	1 07	20 5 cm	1 370
5 5 cm	1 078	21 cm	1 380
6 cm	1 086	21 5 cm	1 395
6 5 cm	1 093	22 cm	1 407
7 cm	1 101	22 5 cm	1 420
7 5 cm	1 110	23 cm	1 433
8 cm	1 118	23 5 cm	1 445
8 5 cm	1 126	24 cm	1 460
9 cm	1 136	24 5 cm	1 476
9 5 cm	1 142	25 cm	1 490
10 cm	1 150	25 5 cm	1 505
10 5 cm	1 160	26 cm	1 520
11 cm	1 170	26 5 cm	1 535
11 5 cm	1 180	27 cm	1 550
12 cm	1 188	27 5 cm	1 565
12 5 cm	1 198	28 cm	1 581
13 cm	1 207	28 5 cm	1 600
13 5 cm	1 216	29 cm	1 615
14 cm	1 225	29 5 cm	1 630
14 5 cm	1 235	30 cm	1 650
15 cm	1 245	30 5 cm	1 670
15 5 cm	1 256	31 cm	1 688
16 cm	1 266	31 5 cm	1 705
16 5 cm	1 277	32 cm	1 725
17 cm	1 288	32 5 cm	1 745
17 5 cm	1 299	33 cm	1 765
18 cm	1 310	33 5 cm	1 788
18 5 cm	1 320	34 cm	1 808
19 cm	1 330	34 5 cm	1 830
19 5 cm	1 342	35 cm	1 850
20 cm	1 356		

ing. The circumference in the lateral view is then measured and the film-object distance determined by measuring from the center of the fetal head to the lateral border of the greater trochanter and adding the distance from the table top to the film. Again the linear magnification is found to be about equal to the soft tissue thickness.

The two readings will usually vary less than two centimeters. A mean circumference is determined. For the mean circumference there is a calculated volume in milliliters on the circular chart.

Now the anteroposterior diameter (true conjugate) of the pelvis is determined by tracing the small wheel from the anterosuperior border of the sacral promontory to the posterosuperior border of the symphysis. The correction of linear magnification in this plane is made by measuring the distance from the symphysis to the greater trochanter of the femur and adding

the table top-film distance. The correction is then determined and figures upon the dial show the true anteroposterior di-

The body weight of the fetus is reported as the average weight for a known circumference of head (Table IV). The majority

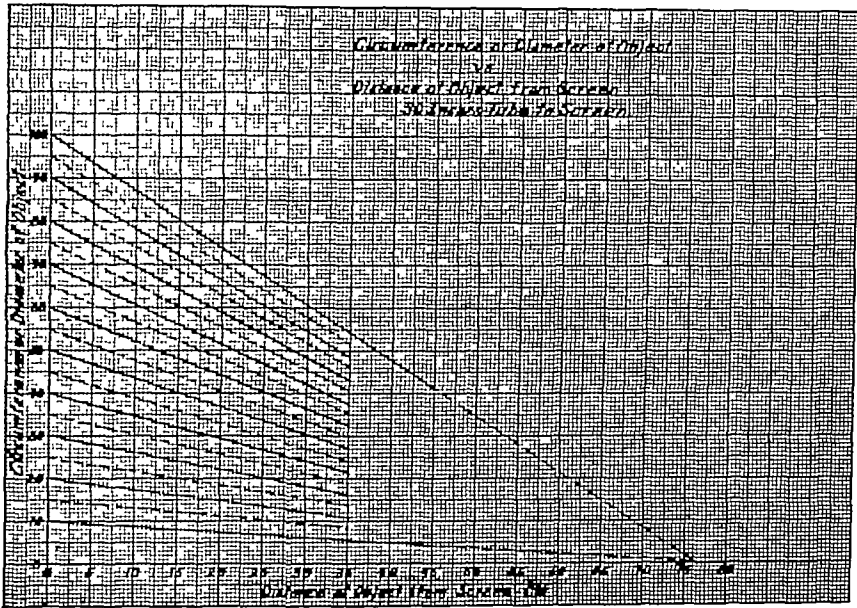


Fig. 4 A rectangular chart correcting two variables for comparison with Figure 2

ameter. The third row of figures gives the volume in milliliters of a sphere of this measured diameter. The ischial interspinous diameter is then determined by tracing the instrument between the two ischial spines in a straight line and the distance of the spine from the film obtained from the lateral view. For this corrected measurement, there is a figure (on the dial) representing the volume capacity of a sphere of this diameter. A comparison can then be made between the volume in milliliters of the cranial skull and the volume capacity of the shorter diameter of the pelvis. If the position of the fetal head permits, i.e., the cardinal diameters are not foreshortened by obliquity, the diameter may be taken, if desired, as advocated by others. Because it is a convenient distance this presentation has been made for a 30-inch target-film technic, although if desired any target-film distance technic can be used with appropriate correction chart on the dial.

TABLE IV —TABLE, SHOWING THE AVERAGE BODY WEIGHT FROM MEAN CIRCUMFERENCE MEASUREMENTS OF OCCIPITO-FRONTAL AND SUBOCCIPITO-BREGMATIC CIRCUMFERENCE, IN A NEW-BORN INFANT

Mean Circumference	Body Weight	
	Pounds	Ounces
28 cm	4	8
28 5 cm	4	11
29 cm	5	1
29 5 cm	5	5
30 cm	5	12
30 5 cm	6	0
31 cm	6	4
31 5 cm	6	7
32 cm	6	10
32 5 cm	6	13
33 cm	7	10
33 5 cm	8	2
34 cm	8	6
34 5 cm	8	10
35 cm	8	14
35 5 cm	9	2
36 cm	9	5
36 5 cm	9	9

can be estimated within 8 ounces. The mean circumference of the occipito-frontal and suboccipito-bregmatic measurements will average two cm greater in the new-

born than the bone measurements taken from films. This difference is due to the thickness of the scalp, which will average two millimeters. The actual volume of the fetal head must be determined by adding two centimeters to the measurement as read from the film. The weight table is constructed from measurements made from both molded and unmolded heads immediately after birth. The mean circumference refers to the occipito-frontal and suboccipito-bregmatic circumference measurements. The table is subject to correction after more data are obtained from a larger series of cases, from all sections of the country.

The rate of increase in the size of the fetal head has not heretofore been obtainable. The above technic makes it possible to obtain this information relative to the cranium of the fetus and when this has been determined in a great number of cases, it will be possible to state with fair accuracy the size and weight of the fetus at the time examined and at successive weekly intervals. The most probable optimal time for the examination is probably at the calculated end of the eighth month of gestation or at any time of suspected or anticipated disproportion.

RESULTS

Over sixty cases have been examined by the above technic. The mean circumference of the fetal cranium has been accurately stated to within one centimeter previous to delivery in over 85 per cent of the cases, the remainder were within two centimeters. The total weight was stated within eight ounces in over 85 per cent of the cases, the remainder were within one pound. This consecutive series represents various types of presentations as they occurred. Five caesarean sections, three multiple pregnancies, three cases of transverse position, and four of breech presentation are included in this group.

SUMMARY

A simplified technic for roentgen pelvimetry and fetal cephalometry is presented.

A circular chart which corrects two variables is presented with a new instrument, the pelvicepholometer.

The mean circumference of the fetal cranium is found to be a very dependable, accurate means of estimating the volume and is applicable for predicting the size of the fetus.

It is suggested that a comparison of the volume of the fetal head, calculated from the circumference, be made with the volume of a sphere calculated from a diameter measurement obtained from the smaller pelvic diameter. This comparative volume ratio is an index which will shift with the increase of the fetus and may well indicate the need for close observation of the patient.

We suggest a routine roentgen examination at some time during the last calculated month of gestation.

We wish to acknowledge the invaluable aid of Dr. Edward F. Buchner, Jr., in the development of this technic. His insistence upon more accurate mensuration prompted our efforts. We wish also to acknowledge with much gratitude the aid of Miss Amelia Wilson, x-ray technician, in the experimental work done, also to Mr. D. R. Swingle, B. S. E. E., and Mr. K. E. Hapgood, B. S. E. E., for their aid in checking the mathematical calculations.

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BUCHNER, EDWARD F JR Undistorted Radiography in Obstetrics Tenn St Med Jour in press

ENCEPHALOGRAPHIC EXPERIENCES MEDICO-LEGAL DEDUCTIONS

By E S GURDJIAN, M D , and H A JARRE, M D , *Detroit, Michigan*

THE clinical value of encephalography, well performed and correctly interpreted, cannot be overestimated. The procedure has made possible many a correct diagnosis and prevented numerous useless cranial operations. Nevertheless, important points deserve further clarification, as one might easily realize from the discrepancies recorded in the literature.

Of all the various spaces demonstrable by encephalography only one system, the ventricular, is well known. Conceptions concerning the epi- and sub-arachnoid spaces and their physiologic interrelationship are at variance, sufficient information is not yet available about the fluid-equilibrium between cerebrum and pericerebral spaces under different physiologic and pathologic conditions. The work of Locke and Naffziger, done under technical difficulties on autopsy material, cannot remedy this situation. A wide divergence of opinion concerning the interpretation of peripheral collections of air, therefore, is understandable.

As a contribution to correct evaluation of encephalography we wish to present several points for discussion in this paper. We base our opinions on experiences with a fairly large amount of material from Grace Hospital and the Receiving Hospital of Detroit, Michigan.

Some physical factors influencing demonstrability of intracranial fluid-spaces and governing the distribution of the injected air—The existence of a positive spinal fluid pressure enables us to remove part of this fluid in the usual manner, but a complete evacuation probably cannot ever be expected. Were this fluid contained in a cube, sphere, or a similar vessel, its evacuation would be simple, but the peripheral intracranial fluid spaces are most irregular, segmented, tortuous, shallow in parts, deeper in others, with most complicated

intercommunicating channels of, in all probability, variable lumina. One cannot anticipate complete drainage of such a system by available methods. When the intracranial pressure has receded gradually to a low point, considerable fluid will always remain in corners, angles, and recesses of the subarachnoid spaces, and one would expect that admixture of air to such residues must produce variable bizarre and unusual lakes. The average amount of fluid obtained in adults is between 100 and 150 c c , of course, occasionally more can be withdrawn. Differences in substitution must of necessity produce different images and should be taken into consideration for interpretation, though widely applicable standardization of all technical procedures should be striven for.

The physical forces of capillary attraction and surface tension of necessity play a rôle in governing the distribution of air and fluid in these irregular peripheral spaces. Bubbles form, which may easily become trapped or imprisoned here and there and interfere with further flow of these media. Their presence alone may be sufficient to produce over-inflation of one sector and prevent the usual aëration of another. Thus forces come to play on the gelatinous consistency of the brain which lead to a more or less pronounced shoving or molding of this substance, the possibility of which, of course, is well known from observations of epi- or subdural hematomas. When, in addition, one considers that the amount of blood within the skull may undergo marked changes, then one conceives of the uncontrollable variability in pericerebral encephalographic images and the limitations of this diagnostic procedure.

In approximately 8 per cent of our patients no air was admitted into the ven-

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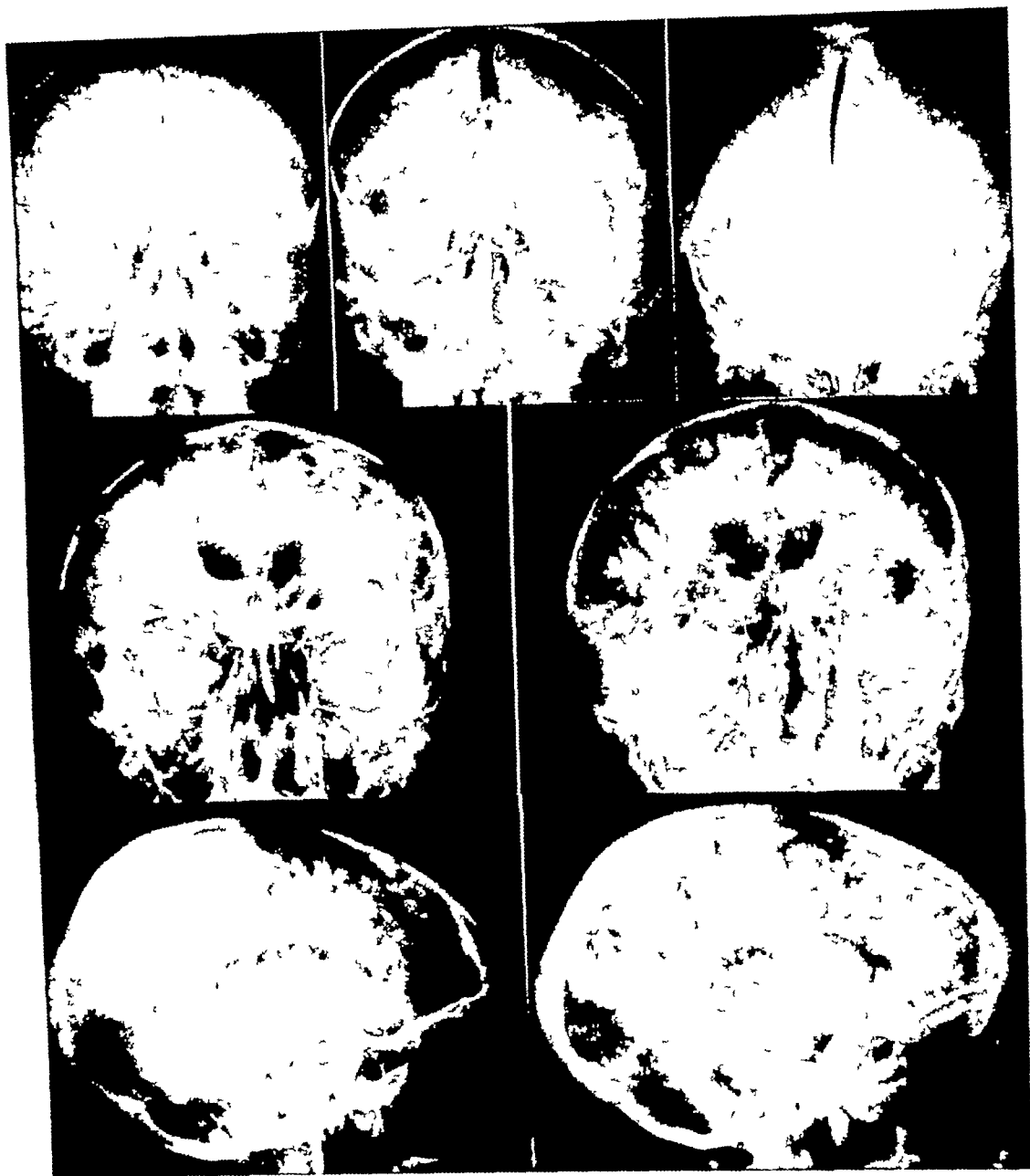


Plate I

tion of 60 c c of air shows little cortical markings, but an additional injection of 70 c c shows a marked contrast to Figure 6. These films prove beyond doubt that in different hands encephalography may produce varying interpretations because of technical variations.

Plate II. Figures 1, 2, 3, and 4 show incidental, uncontrollable subdural escape

of air in two cases. As a result of this accident, spaces normally shown, especially the ventricles, are not demonstrated at all or but incompletely, poorly, or asymmetrically outlined. The ventricles probably collapse more or less completely in such instances, thus creating the space for the peripherally depressed brain substance. This occurrence should not be misinter-

tricles at the first encephalographic exploration though a sufficient exchange was performed. Quite a few of these patients were re-investigated in some instances a second encephalographic attempt secured an entirely normal response, while in some others ventriculography was resorted to and either a normal ventricular system was found or occasionally an internal hydrocephalus.

The conclusion of a pathologic basal obstruction on the basis of a single encephalographic attempt would be regarded as hasty and premature. Such a final conclusion is justified only after positive ventriculographic demonstration of an internal hydrocephalus. Encephalographic non-visualization of the ventricular system may be the result of (a) incidental, non-significant obstruction, (b) pathologic occlusion, or (c) increased intracranial pressure of variable etiology.

The latter condition, operative in prevention of encephalographic ventricular visualization, was encountered five times in patients with tumors: a left temporo-sphenoidal, a frontal, a left parietal, a right thalamic tumor, a gumma of the right cerebellum and the fourth ventricle. In two of these cases a satisfactory demonstration was obtained subsequent to large exploratory decompressions, thus proving to our satisfaction that originally increased intracranial pressure prevented admittance of air beyond the basal cisternæ, and that reduction of this pressure by operation corrected this original difficulty. Variations in intracranial pressure under different physiologic and unphysiologic influences deserves further study.

Finally, one should admit that adhesions of the pia arachnoid, as demonstrated at biopsy or autopsy, may explain some cases of non-admission of air to any or all segments of the cerebral fluid-systems. However, in recognition of the conditions discussed concerning the many possibilities of interference, one should be reluctant to quickly and frequently render such a diagnosis on encephalographic evidence only.

Summary—The following physical fac-

tors and forces have to be considered in encephalographic interpretations:

- (1) Character and structure of the peripheral fluid spaces,
- (2) Quantity of air exchanged for fluid,
- (3) Capillary attraction and surface tension,
- (4) Gelatinous consistency of the brain,
- (5) Variable intracranial blood-content and cerebromeningeal hydration,
- (6) Basal obstruction, incidental or pathologic,
- (7) Abnormally increased intracranial pressure,
- (8) Adhesions of pia arachnoid.

Usually several of these factors are co-operative in the production of pictorial variants.

Plates I and II were chosen to demonstrate fallacies of encephalography such as might arise from non-consideration of some of the points stressed.

Plate I Variations resulting from fractional fluid-air exchange and molding of the cerebrum (three cases)—In Figures 1, 2, and 3 there is an exchange of 50, 100, and 145 c c, respectively. Note the increasing visibility of the peripheral spaces, while the ventricles are not filled—they may have been collapsed and thus allow the escape of air into the subdural spaces, with subsequent dislocation of the brain. Air also is trapped between the hemispheres. This demonstrates the incidental asymmetrical midline shift of the hemispheres—molding of the gelatinous cerebral substance under the influence of unequal peripheral pressure.

In Figures 4 and 5, the method of fractional injection of air was also used. There is a marked difference in cortical markings with varying degrees of insufflation. In Figure 4, one is tempted to assume the absence of air over the hemispheres after the initial injection of 50 cubic centimeters. In Figure 5, after injection of an additional 70 c c of air, the picture was changed materially. In this film there is seen a marked collection of air over both hemispheres. The same condition prevails in Figures 6 and 7. In the former an injec-

preted as cerebral or cortical atrophy. Figures 5 and 6 show the result of a second encephalographic exploration on the patient shown in Figures 3 and 4. These images must be regarded as normal. A comparison between the second and third row of these illustrations must caution every interpreter not to draw hasty conclusions. Figure 7 is a roentgenogram of a case of non-admission of air beyond the basal cisternæ because of the presence of a supratentorial brain tumor (left temporo-sphenoidal astrocytoma) producing abnormally high intracranial pressure. Figure 8 shows the findings in a successful encephalography following decompression, in a case of melanosarcoma of the left frontal lobe. No demonstration of intracranial fluid-spaces could be obtained before reduction of abnormally high intracranial pressure.

Of patients investigated encephalographically four groups attract particular interest on correlation of clinical and encephalographic observations. These are (a) cases with marked clinical manifestations of severe cerebral damage but with little or no encephalographic evidence of disease, (b) cases with clinical manifestations of mild, non-incapacitating cerebral damage but with pronounced, striking encephalographic defects, (c) cases in which the encephalographic demonstration of cerebral pathology is well in proportion to anticipations on clinical evidence, (d) cases in which the type of pathology could only be found by radiographic procedure.

(a) *Case with marked clinical manifestations of severe cerebral damage but with little or no encephalographic evidence of disease.* Such patients are encountered quite frequently, but concerning this group especially one can find a wide variance of opinion in the literature. For instance, Stone and Jones find normal encephalograms in 60 per cent of cases with traumatic epilepsy, while in the opinion of Pendergrass and Fay some kind of pathology can be shown roentgenologically in nearly all patients with convulsive states. Winkler reports normal radiologic findings

in more than 50 per cent of his patients afflicted with feeble-mindedness.

Plate III shows records of six such patients (Fig 1) Little's disease with marked quadriplegia, birth injury—normal encephalogram (Fig 2) Severe left hemiplegia following skull injury, mild ventricular asymmetry, no air in sub-arachnoid spaces (No repetition of procedure so far) Roentgenologic findings appear quite insignificant (Fig 3) Marked feeble-mindedness, age 16, mental age, 6, normal encephalogram with somewhat large but well-formed ventricles (Fig 4) Traumatic epilepsy with frequent, severe attacks, the encephalogram probably would be regarded as normal by many interpreters, one might, however, draw attention to somewhat noticeable drainage of peripheral fluid-spaces (Fig 5) Left hemiplegia, apoplexy, mild ventricular enlargement with slight asymmetry (Fig 6) Traumatic epilepsy with frequent severe attacks, cortical defect in right parietal area, slight ventricular asymmetry.

May we repeat, these cases illustrate an incongruity, namely, severe, incapacitating cerebral diseases on one hand, normal or but slightly abnormal encephalograms on the other. The seriousness of the clinical condition is not at all reflected in the roentgenogram. Normal or nearly normal encephalograms by no means indicate normally functioning brains or absence of nervous disease or headache.

(b) *Cases with clinical manifestations of mild, non-incapacitating cerebral damage but with pronounced, striking encephalographic defects.*

Plate IV shows records of four such patients (Fig 1) Occasional mild epileptic spells, months apart, during the last five years, no complaints of headaches or dizziness, patient is an active preacher, apparently satisfactory for the needs of his congregation. Compounded, depressed cranial fracture fourteen years previously, syphilis under therapeutic control. Large cranial defect, corresponding cerebral defect, internal hydrocephalus of moderate degree (Fig 2) Since en-

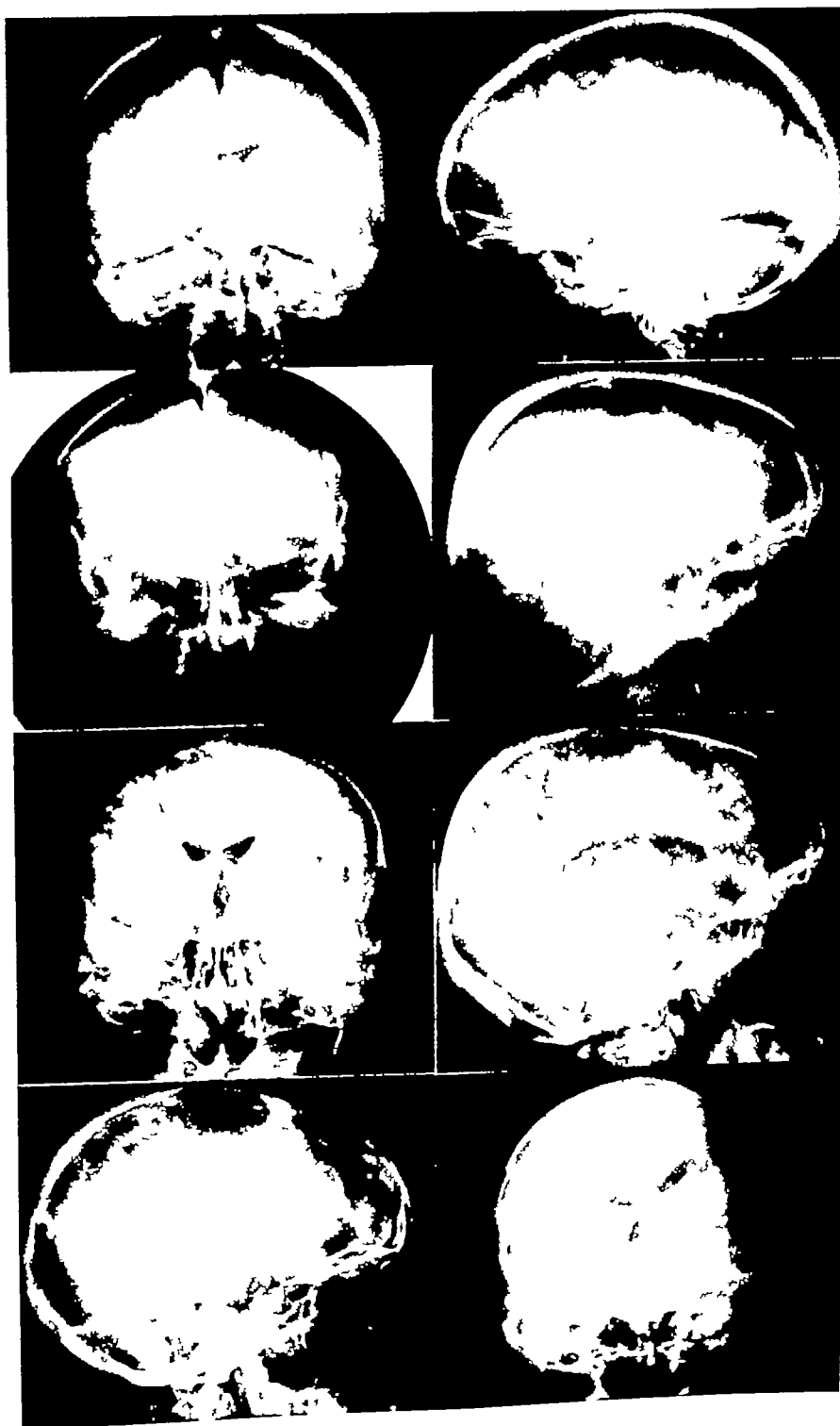


Plate II



Plate IV

cephalography was done, the patient (an active housewife) has had normal mentality, no complaints of any kind, six weeks before, a cranial fracture with temporary marked disorientation and psychosis, investigation in search of a possible subdural hematoma internal hydrocephalus of moderate degree, no peripheral fluid-spaces outlined (Fig 3) Occasional headaches and dizziness, patient (a policeman on active duty) suffered a cranial fracture three years prior to investigation, no improvement from encephalography, 230 cc of fluid removed, cerebral atrophy of moderate degree (Fig 4) Occasional

attacks of headaches and dizziness for twelve years, clinically improved since investigation, encephalitis fourteen years before, patient was an active police-lieutenant, who performed his duties well enough to earn repeated promotions during the period of complaints, marked cerebral atrophy

May we emphasize the lesson to be learned from this group of patients encephalographically shown marked cerebral defects are not necessarily coincident with similarly marked mental or nervous deficiency, one cannot judge a patient's mentality or brain function from his en-



Plate III



Plate IV

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Plate V

cephalographic records

In pronounced contrast to these two groups of patients, who showed decided disproportion between clinical and encephalographic symptoms, we have to demonstrate two additional groups, which are of interest in that they chiefly justify the employment of this diagnostic method.

Plate V illustrates cases in which (c) *encephalographic demonstration of cerebral pathology is well in proportion to anticipations on clinical evidence*—(Fig 1) Right hemiplegia due to a vascular accident, marked atrophy of left hemisphere with some asymmetry and distortion of ventricles (Fig 2) Spasticity on both sides, more marked on left, aphasia, patient bedridden, cranial fracture with brain

damage two years before. Marked asymmetrical internal hydrocephalus, no air over surfaces of hemispheres (Figs 3 and 4) Patient's clinical condition suggestive of progressive left parietal lesion, marked shift to the right, obliteration of posterior horn of the left lateral ventricle, tumor in the left posterior parietal region.

Plate VI (d) *records of a few selected cases, in which the type of pathology present could be found only by radiographic procedure* (Fig 1) Left-sided hemiplegia, right parietal porencephaly resulting from birth injury (Fig 2) Epilepsy, mental retardation, internal hydrocephalus, so-called fifth ventricle. (Fig 3) Mild traumatic epilepsy, gunshot injury sixteen years before, entirely

symptomless for twelve years, since which time there have been occasional epileptic attacks, porencephaly involving the right frontal lobe

DISCUSSION

It is apparent from the preceding demonstration that encephalography is useful

the absence of much clinical evidence for such findings. The possibility of technical accidents with resulting bizarre manifestations in the encephalogram also causes much confusion. Patients with deteriorating mentality may present, in encephalograms, a variety of changes irrespective of clinical manifestations. For instance, in



Plate VI

only in conjunction with a careful neurologic evaluation. Such a study will eliminate from this type of investigation all patients offering a clear-cut clinical diagnosis or promising no information from the roentgenologic search, which, after all, is not without inherent distress and danger.

Genuine brain damage may not be demonstrable by visible findings in the encephalogram. Encephalographic records, on the other hand, may show relatively extensive pathologic processes in

epilepsy we may find any of the following abnormalities: enlarged ventricles, asymmetrical ventricles, porencephaly, varying degrees of enlargement of subarachnoid channels, lack of air in subarachnoid channels, a combination of any of the above, perfectly normal encephalographic images. It is evident that with so many possibilities of explanation for the causation of the pathologic basis of epilepsy, the investigator's subjective preferences in interpretation are given a wide leeway.

Traumatic epilepsy is only one example, the same is true of a number of other conditions for which patients are treated by encephalography. It is pertinent, therefore, to state that encephalography constitutes a diagnostic procedure which may or may not be of help in the diagnosis, it furnishes part of the material for a diagnosis but is not the diagnosis *per se*.

Encephalographic reports are based on variations in the distribution of air in the ventricles and the subarachnoid channels. In a satisfactory encephalogram the study of the ventricular cavities is most reliable and it is felt that it should be the basis for pathologic classification. The subarachnoid spaces may present the following variations: (1) shadows only in the basal cisterns, (2) over the convexity of the hemispheres (the latter may show different degrees of insufflation varying from few blood-vascular and gyral markings to large confluent masses of air over one or both hemispheres), (3) demonstration of intercommunicating channels.

Diagnoses based on changes in ventricular outlines are trustworthy. The variability of the subarachnoid spaces, however, represents a difficult interpretative problem, especially in the presence of normal ventricles. Pia-arachnoiditis should be assumed only hesitatingly and requires corroboration by histologic study. Too much depends on uncontrollable physical factors to make this diagnosis justifiable in many instances. Localized, circumscribed arachnoid adhesions may logically be assumed more readily as sequelæ to compound cranial fracture with cerebral laceration than generalized arachnoiditis for the explanation of headaches and dizziness of undetermined cause. Words of caution are also timely concerning the so-called brain atrophy in the presence of normal ventricles; one should be most careful with the analysis. The demonstrability of subarachnoid channels varies with time and individuals, wide subarachnoid channels are not necessarily pathologically enlarged pathways. They are larger, as a rule, in the anterior parts of the skull than pos-

teriorly, but why they should not show in posterior segments, if only a complete substitution of air for fluid were obtained, is not explainable. There is no reason why the presence of air in the island of Reil should be considered evidence of brain atrophy, as long as structural conditions of the meninges in this turned-in portion are not different from any other superficial ones. Non-aeration of this recess should attract at least as much attention as aëration. To establish an arbitrary rule as to which surface-portion of the brain should be found aërated and which should not, seems rather premature. When large air collections are found over one or both hemispheres and the ventricles are not seen, the probability of an artefact becomes great—the brain often has collapsed into the ventricular spaces, the elimination of which has created room for the peripheral accumulations of gas. In such a case, the encephalographic procedures should be repeated. Yet, after all, a well directed study of all subarachnoid channels is most valuable as one may readily judge from the work of Stone and Jones and also of Dyke.

Gradually we will learn more about the significance of some of the encephalographic findings which now are poorly understood, especially we shall try to find out to what extent demonstrable cerebral deficiency is compatible with the patient's earning ability. At present, we admit that enlargement of the ventricles is pathologic, however, it may not be incapacitating at all, as shown above. Brain trauma may cause pronounced defects and distortions, yet the lack of clinical symptoms often is astonishing. Undoubtedly, therefore, ventricular deformity in certain cases is compatible with good health and average wage-earning ability. As concerns the subarachnoid spaces, we have demonstrated that patients with marked deviations from the normal are able to carry on satisfactory, remunerative work for years, while others with normal structural appearance are invalids.

We must urge great caution, therefore,

in the judicial use of encephalograms before any tribunal. We must realize that encephalograms are not diagnoses—that they are merely a part of the material for such, like any other roentgenogram. They may either be of decisive importance for a diagnosis, or irrelevant. A positive clinical diagnosis may not need encephalographic support, a doubtful clinical differential diagnosis may be decided by it or not—often enough not. To establish the genuineness of complaints or malingering, careful detective work and cinematography may be more important than encephalography. Mental ability certainly cannot be demonstrated by this method, neither can earning capacity be established or the progression of changes be predicted on its basis. A normal encephalogram should not be construed as indicative of malingering, and a pathologic encephalogram does not necessarily substantiate complaints.

SUMMARY

1 Physical factors which influence encephalographic demonstration of intracranial fluid-spaces and govern the distribution of the injected air are discussed. Failure of recognition of these forces may lead to erroneous interpretations.

2 Incidences of disproportion between neurologic manifestations and encephalographic findings are shown—cases with marked clinical evidence of severe incapacitating cerebral disease and relatively normal encephalograms, and also cases with the reversed relationship.

3 Observations are recorded in which encephalographic demonstration is well in proportion with clinical manifestations, or which could not have been made by any method other than encephalography.

4 The necessity of careful correlation of all clinical-neurologic and encephalographic data is stressed and a warning is sounded against the indiscriminate judicial use of encephalograms, with neglect of clinical neurology.

Traumatic epilepsy is only one example, the same is true of a number of other conditions for which patients are treated by encephalography. It is pertinent, therefore, to state that encephalography constitutes a diagnostic procedure which may or may not be of help in the diagnosis, it furnishes part of the material for a diagnosis but is not the diagnosis *per se*.

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We must urge great caution, therefore,

Case 8 Adamantinoma, with large solitary metastasis to the pelvis There was a pathologic fracture through the acetabulum Autopsy revealed a few

³ Congenital hemolytic jaundice has been included in this study because of the peculiar bone changes which

Metastatic to

[illegible]

⁴ A few cases exhibiting both productive and destructive lesions are grouped under the productive type.

CANCER METASTATIC TO BONE¹

By WALTER A FORT, M D , Lieutenant Commander, Medical Corps, U S Navy,
Mare Island, California

From the files of the radiological departments of Stanford University Hospital and San Francisco County Hospital, San Francisco California*

WHEN cancer cells become detached from the primary growth to circulate in the blood and lymph, it is quite logical to expect that some of them will lodge in bony structures. Autopsy reports lead one to believe that this actually occurs much more frequently than we once supposed. The fact that the condition is often unrecognized antemortem is probably due to several factors, some of which are as follows

1 Considerable proliferation of the transplanted cancer is usually necessary before signs or symptoms appear

2 Small lesions of bone are difficult to detect in the roentgenogram

3 In advanced cases of cancer, with general metastases, it often seems superfluous to search for bony invasion

A wide variance of percentages of incidence for bone invasion would be obtained by a clinic which searched the skeleton for purposes of confirming the diagnosis, and by an institution which observed cases in the late stages of the disease. This study, therefore, makes no attempt to gauge the incidence of metastases to bone. It merely attempts to point out the favorite locations for transplants in bone by various types of cancer and to show that practically any type will grow in bony tissue in some patients

The appended table presents 259 cases

¹ Work done as part of graduate instruction in Radiology at Stanford University School of Medicine based on material at Stanford University Hospital, Department of Radiology and the Stanford University Medical Service. San Francisco Hospital, Department of Public Health of the City and County of San Francisco

* The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department of the Naval Service at large

(Signed) W. A. FORT

of carcinoma, 28 cases of other types of cancer, and 21 unidentified types that showed roentgen evidence of metastasis to bone². A comparison with some of the reports from other sources is instructive.

Sutherland, Decker, and Cilly (1) reported 1,032 cases of cancer, observed at the Mayo Clinic, which showed metastatic lesions in bones (Series I). Copeland (2) reported 334 cases of cancer with bone metastasis, observed at the Johns Hopkins Hospital (Series II).

In Table I, some of the more important observations of the above mentioned observers are compared with ours (Series III).

TABLE I

Primary	Series I	Series II	Series III
Breast	38%	30%	36%
Prostate	28%	40%	16%
Lung	1%	1%	5%
Kidney	5%	6%	2%
Thyroid	2%	2%	1%
Stomach	2%	2%	1%
Colon	1%	1%	2%
Uterus	2%	1%	4%
Bones Involved in			
Order of Frequency	spine pelvis femur ribs skull	spine pelvis femur skull ribs humerus	pelvis spine ribs femur skull scapula clavicle humerus

The following are among the more interesting cases of our series

Case 1 Sarcoma, primary, in the rib of a 25-year-old male, with metastasis to skull, pelvis, ulna, and other long bones. This was a slow-growing tumor. Several metastatic foci in the lungs were calcified. Microscopic sections from autopsy material suggested angio-sarcoma in some tissues and fibro-chondro-sarcoma in others.

² Metastases are listed in all places found, but undoubtedly occurred in other bones and were not discovered because (1) they were too small to be identified, (2) no examination was made of that part of the skeleton

THE TREATMENT OF EPITHELIOMA OF THE CHEEK¹

By GEORGE E. PFAHLER, M.D., Sc.D., Philadelphia

IN general, cancer of the mouth is one of the most painful, distressing, and fatal diseases known when it has reached an advanced stage. On the other hand, it is a disease that is easily observed by both the patient and the physician. It causes symptoms early and, therefore, should be recognized in its earliest stages. In fact, in my opinion, the lesions that precede cancer should be treated thoroughly and skillfully, and I believe that for the most part, cancer of the mouth can be pre-

small but fully developed lesions, and an extravagant sacrifice of tissue in mild cases, are common errors committed in the case of these patients, and are largely responsible for the ultimate mortality and for that dread of the disease which leads many to conceal its existence as long as possible."

I believe that if it can be made known that the precancerous lesions and the early cancers of the mouth can be cured by irradiation with no pain or by simple electrocoagulation, plus thorough and skillful



Fig 1-A Case 1 Shows the cancer involving the inside of the right cheek and also extending down to and involving the alveolar process and the ramus of the jaw (Sept 23 1929)

Fig 1-B Case 1 Shows the mouth entirely well remained well for four years, after which time the patient died of some hemorrhage from the bowel, cause unknown (Photograph April 3, 1930)

vented. In spite of the fact that cancer of the mouth can be prevented, and in its earliest stages can be cured, it remains one of the most frequent and fatal types of cancer. According to Ewing, in frequency, it has been placed second by Jessett, third by Jacobson, and fourth by Winawarter.

I quote Ewing as follows: "The failure to recognize the significance of early or precancerous conditions, temporizing with

irradiation, that we will be taking a very long step toward the elimination of the fear of this disease, and will prevent many of the deaths that are now occurring. Warren, Butlin, and Meller give a mortality of this disease at present of 75 to 90 per cent. In my opinion, 75 per cent of these cases should get well if treated completely and thoroughly at the beginning. Such results, however, demand the thorough cooperation on the part of both the public and the physicians.

Epithelioma of the Mucous Membrane of

¹Read by title before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis, Tenn., Dec 3-7, 1934.

small lesions in the ribs No other metastases were found

Case 9 Endothelioma, primary in the femur, with metastasis to femur and pelvis

Case 10 A patient with two primary carcinomas, one in the lung and the other in the uterus, with metastases to bone from each This patient also had Paget's disease of the femora (autopsy-proven)

CONCLUSIONS

1 Carcinoma of the breast and prostate are responsible for from 50 to 70 per cent of all cancer metastatic to bone

2 Bone transplants from hypernephroma, carcinoma of the colon, thyroid, lung, and uterus, are fairly common

3 Metastasis to bone from sources other than the above is not common

4 Metastasis to bone from skin cancer is rare

5 The pelvis and spine are the favorite locations for bone metastases of all kinds Next to these, cancer prefers the ribs, femur, and skull

6 Osteoclastic lesions are about four times as frequent as the osteoplastic type In carcinoma of the prostate, productive types are about twice as frequent as the destructive

The author is deeply indebted to Professor R. R. Newell and the Staffs of the radiological departments of Stanford University and San Francisco County Hospitals for their advice and assistance

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These patients should not have the lesions in the cheek treated repeatedly by any form of caustic such as carbolic acid or nitrate

Case 1 Male, aged 74 years, was referred by Dr J M Schuldkraut, of Trenton, N J, on Sept 23, 1929, because of



Fig 2-A Case 2 Lateral view, showing complete healing in the case of a carcinoma involving the inside of the cheek and the alveolar process. Treated by irradiation, then electrocoagulation, on Nov 23 1918, followed by resection of the jaw and a plastic operation. Patient still well, 16 years later.
Fig 2-B Case 2 Shows anteroposterior view of the same case

of silver. In the earliest stages, when only a whiteness of the mucous membrane is present, it may be sufficient to remove the cause whether it be from tobacco, mechanical, chemical, or bacteriologic irritation.

When one is dealing with a fully developed epithelioma of the cheek, the problem is very serious. If the lesion is malignant, small local surface destructions by electrodesiccation on the inside of the cheek are likely to be a failure, because the disease commonly extends more deeply than is estimated. The associated congestion that follows such destruction leads to the rapid development of the carcinoma, unless it is thoroughly controlled by sufficient irradiation. I have had success in the treatment of these lesions when the entire cheek was excised but at the present time, when one can use sufficient gamma irradiation from radium, or make use of highly filtered high voltage x-rays, I believe that electrocoagulation will probably rarely be necessary. Where the disease has extended from the cheek into the alveolar process, and especially when it has reached the inferior dental canal, it is often advisable to resect a part of the lower jaw going well beyond the diseased area, as is indicated by the following case:

carcinoma involving the entire inside of the right cheek, and associated with destruction of the alveolar process and the ramus of the jaw. The disease had extended below the inferior dental canal. For approximately 55 years, the patient had smoked a pipe almost continuously while at work. He had developed some kind of a lesion in his right cheek five years previously, at which time he was ordered to stop smoking. He had an operation on the cheek and cheek bone, the latter having been scraped by the attending physician. This seemed to be followed by recovery lasting a short time, when a recurrence developed. At the time of coming to me for treatment, he was still smoking moderately. In addition to the disease involving the cheek and the jaw bone, he had a chain of lymph nodes extending along the sterno-cleido-mastoid muscle, which were dense and about the size of a pea. Dr Lawrence Rogers reported that he had excised from this same patient, an epithelioma from the left lower lip four years previously. At that time, he had a small ulceration in the right cheek which Dr Rogers curetted and cauterized with nitrate of silver.

Because of the extent of the disease involving the lower jaw, our oral surgeon,

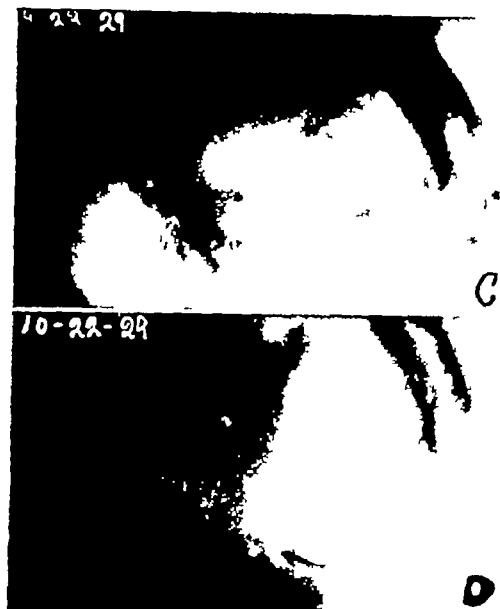


Fig 1-C Case 1 Shows the carcinoma involving the alveolar process and the ramus of the jaw, extending beneath the inferior dental canal

Fig 1-D Case 1 Shows the resection of the ramus and the posterior portion of the mandible, with remaining bone healthy

the Cheek—It is self-evident that an epithelioma which involves the skin externally must be treated on the same principles which apply to any other skin cancer. Generally speaking, these lesions on the skin are of the basal-cell type, but occasionally one finds a squamous-cell type of epithelioma in this region. Then the neighboring lymphatics must be treated thoroughly, just as must be done in any other case of squamous-cell carcinoma. Because of the possibility of squamous-cell carcinoma, even when dealing with cancer of the skin of the cheek, it is my practice to do a biopsy, and then destroy the lesion by electro-desiccation, to be followed by local applications to the extent of 100 to 400 per cent of an erythema dose, using x-rays or radium according to the indications. Only in patients on whom the cosmetic results are of special importance, do I attempt to treat this entirely by irradiation, because of the fact that I like to get a biopsy. If skin cancers are thoroughly treated while only the skin is involved, then practically all can be cured.

The title of this paper is intended to call

attention particularly to the *epitheliomas involving the mucous membrane*. These lesions are always serious in character, always of the squamous-cell type and, therefore, need extensive irradiation of the neighboring lymphatics. Generally, if not always, they begin as the result of a local irritation, such as is caused by the repeated biting with sharp-edged teeth. These teeth may be sharp either from necrosis, or from being worn down in the ordinary course of chewing. I believe, however, that in all cases in which a patient is biting the cheek, a sharp-edged tooth is present, which may not be easily found. If the teeth are old and jagged, one may have this chronic irritation even without biting the cheek. Commonly, such mechanical irritation is associated with that caused by the use of tobacco in excess, either smoking or chewing. I have seen these epitheliomas develop directly in the cheek where the patient was in the habit of holding his quid.

Certainly, such irritation does not develop from a moderate amount of smoking or moderate amount of chewing, but when either is continued over a period of 10, 15, or 30 years, it leads to the development of keratosis or perhaps only whiteness of the mucous membrane, which gradually becomes thickened and ulcerated and develops very slowly. However, a carcinoma may develop in the cheek without the formation of a leukoplakia, the absence of which does not rule out the diagnosis of carcinoma. Syphilis may be an underlying cause, therefore, when a lesion is present in the cheek, a positive serologic test does not exclude carcinoma. When there is any doubt, a microscopic examination should be made. Before taking these biopsies, which I make my routine, we give preliminary irradiation to the extent of at least one erythema dose.

The slowness with which an epithelioma on the inside of the cheek develops leads to carelessness and delay on the part of the patient, and sometimes, on the part of the attending physician, and an early and easily curable case becomes incurable.

These patients should not have the lesions in the cheek treated repeatedly by any form of caustic such as carbolic acid or nitrate

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Because of the extent of the disease involving the lower jaw, our oral surgeon,

Dr Robert Ivy, was called into consultation and it was decided, after preliminary irradiation, that the diseased area involving the right side of the jaw posterior to the canine tooth should be completely resected. The right external carotid was first ligated, and then the diseased portion of the jaw and the diseased soft tissue was excised by Dr Ivy, on Oct 25, 1929. The tissue was reported by Dr Eugene Case as squamous-cell carcinoma. This was then followed by external radium packs, and local applications on the inside of the jaw as follows: using 250 milligrams of radium, with 150 milligrams on the right side, and 100 milligrams on the left, made up with 10 milligram units in 1 millimeter of platinum and 1 millimeter of gold placed upon felt pads, for external applications. These external applications were made in 24-hour periods, on Oct 14, 17, 22, 28, and 31, 1929, Nov 15, 26, 1929, and on May 3, 1930.

Local applications were made inside the mouth on Feb 5 and 20, May 3, and Sept 22 and 23, 1930, giving a total irradiation inside the mouth of 666 milligrams, and externally 49,100 milligrams. The external applications were made in the form of radium packs. The patient remained well until April 3, 1934, when he died of hemorrhage from the bowel, without any evidence of recurrence of his carcinoma about the face or neck. It would seem that it was an independent condition, possibly even carcinoma of the bowel.

At times, one is tempted to destroy the disease by electrocoagulation, which destruction may include the alveolar process. Such destruction is, I believe, generally followed by a necrosis and ultimate sequestrum separation, and sometimes, by a general osteomyelitis of the bone, which then requires resection, as is indicated in the following case.

Case 2. Male, aged 43 years, was referred to me by Dr Lenox Dick, of Darby, Pa., on Nov 23, 1918. The patient had noticed white patches on the inside of the right cheek, three years previously at which time the dentist, while extracting

some diseased teeth, accidentally bruised the inside of the cheek. From that time, it had grown progressively worse. The patient chewed tobacco until five years ago, keeping the quid on the right side. Also, he has had a pipe in his mouth most of the time. The disease was found to involve the central portion of the right cheek on the inside, and extending down to and involving the alveolar process. After preliminary x-ray treatment with low voltage x-rays, the entire diseased area was destroyed by electrocoagulation on Nov 30, 1918. This was followed by x-ray treatment externally, and radium applications on the inside, but only to a moderate extent.

Considerable induration remained at the end of a month. This has been my experience when using partial destruction of the tumors in the cheek by electrocoagulation. The surrounding tissue becomes dense, indurated, and it is almost impossible to decide whether tumor tissue is present or not. On April 22, 1919, the disease was more extensively destroyed, and the cheek itself removed. Even at this time, I had hoped to save the lower jaw, but an osteomyelitis developed, which produced a sequestrum. This was removed together with a resection by Dr William J McKinley, on June 27, 1919. Further applications were made by radium and x-rays, sufficient to produce a very definite erythema. Finally, a plastic operation was performed by the late Dr J C DaCosta and Dr Charles F Nassau, of Philadelphia. The patient has remained well to date, approximately 14 years.

At times, it seems advisable to deliberately destroy the disease, resect the bone, and combine irradiation, as is indicated in the following case.

Case 3. Male, aged 40 years, was brought to me by the late Dr W L Shundle, of Sunbury, and Prof Ernest LaPlace, of Philadelphia, on June 10, 1915, because of a carcinoma, developing during at least eight months. It involved the entire inside of his left cheek, including the upper alveolar process, and the lower jaw,

extending forward as far as the canine tooth, and posteriorly, having destroyed the entire ramus of the jaw (Fig 3-B) he returned to his physician, who then cauterized the area. Since that cauterization, the tumor had grown very rapidly

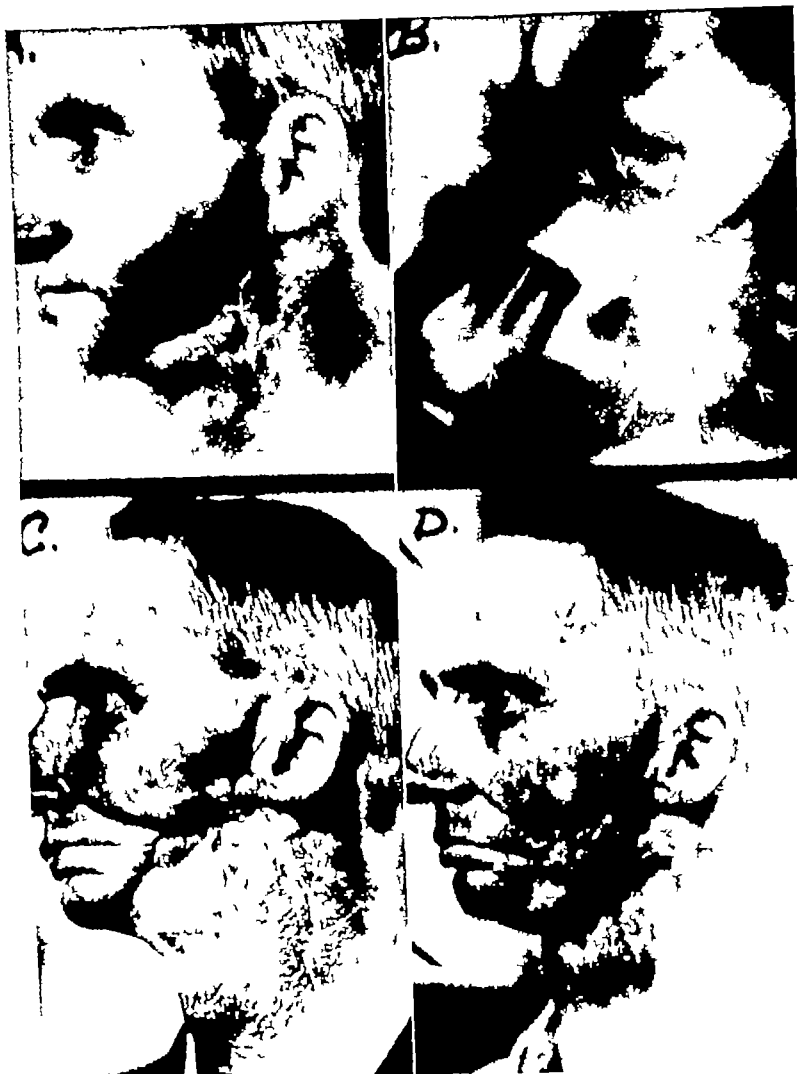


Fig 3 A Case 3 Shows the patient after resection of the lower jaw by electrocoagulation and after separation of the slough. The patient had a carcinoma involving the entire cheek, the upper and lower alveolar process, including all of the ramus of the jaw. A resection of the jaw bone was done by Prof. LaPlace, after the preliminary irradiation and immediately after coagulation in June 1915.

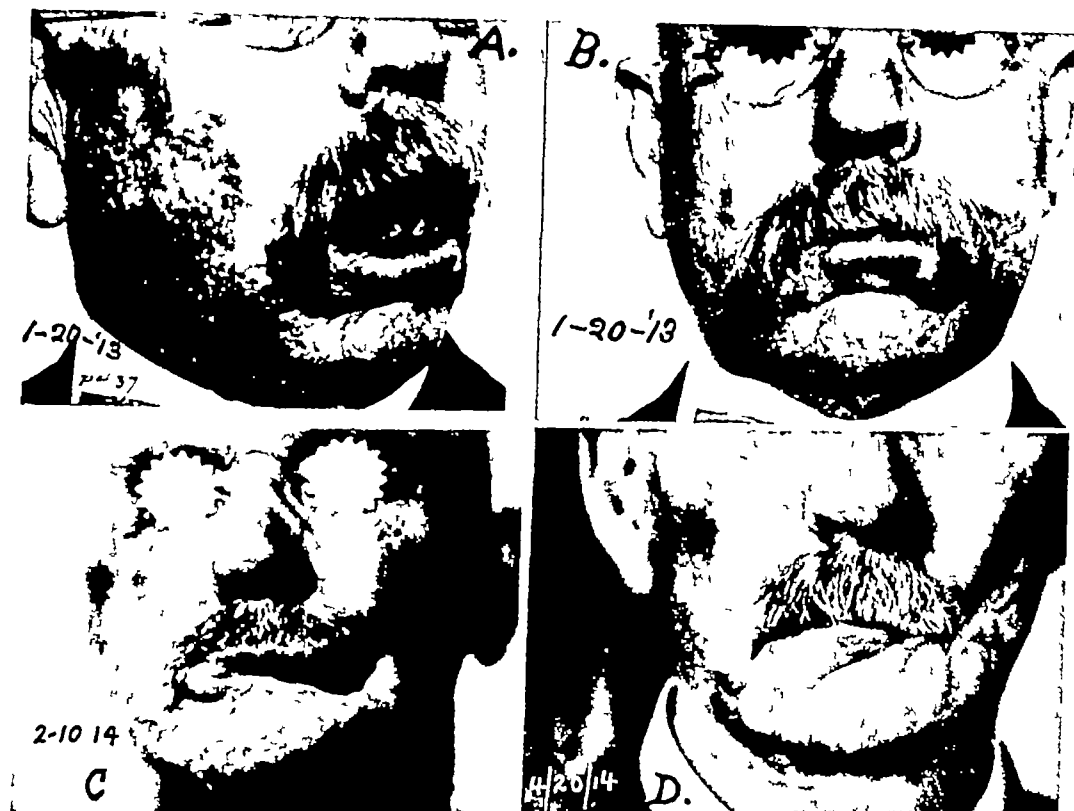
Fig 3 B Case 3 This is a roentgenogram showing the extent of the disease so far as it involves the bone, extending up to the floor of the antrum posteriorly, through the entire ramus, and anteriorly as far as the canine tooth. The tumor tissue had crowded the remaining molar out of its socket.

Fig 3 C Case 3 Shows the patient after a prolonged period of radium and x-ray treatment, and partial plastic operation.

Fig 3 D Case 3 Shows the wound entirely closed. The patient remained well and continued his occupation as a travelling salesman until September 1934 when he died of apoplexy without any local recurrence 19 years after treatment.

When this patient was first seen by a physician he was told to apply iodine locally, a treatment which caused so much pain that

In addition to the local disease, the patient had palpable lymph nodes extending downward along the side of the neck. He had



Figs 4-A and 4-B Case 4 Shows a carcinoma involving the entire inside of the left cheek with recurrence carcinoma about the angle of the mouth. This had been treated previously for some time by x-ray and there was considerable fibrous tissue present. Therefore the entire wound was destroyed by electrocoagulation.

Fig 4-C Case 4 Shows the wound (Feb 10 1914) after electrocoagulation and additional irradiation and after slough had separated which usually requires about three to four weeks. At this time, the patient seemed to be entirely well and was referred to Prof. Ernest LaPlace for plastic operation.

Fig 4-D Case 4 Shows the wound entirely healed, April 20, 1914. The patient remained well until July 9 1926 or 12 years at which time he died of angina pectoris, with no recurrence of his carcinoma.

lost ten pounds in weight. He had been an excessive smoker.

The patient was given preliminary x-ray treatment, amounting to an erythema dose, with low voltage rays, filtered through 6 mm of aluminum, and applied externally. On the following day (June 11, 1915), under general anesthesia, in conjunction with Prof. LaPlace, I destroyed the entire diseased area of malignant disease, and Dr. LaPlace resected the lower jaw as far forward as the region of the lateral incisor tooth. When the bone was examined after removal, it was found that in the angle of the jaw, the disease had extended through the entire bone, which fractured when an attempt was made to remove it. Following this operation, radium was applied into and

against the edges of the wound, for an amount that would ordinarily equal four erythema doses. The radium was highly filtered through 0.5 mm of silver and 1 mm of brass at that time. The patient was then given treatment with low voltage rays over the neck and the side of the face, sufficient to produce a marked erythema and atrophy. This atrophy is shown in Figure 3-C.

Prof. LaPlace made the first attempt to close the wound on April 22, 1916, an accomplishment which was finally completed on Sept 16, 1916. From that time onward, the patient remained well until he died of apoplexy, in September, 1934, at which time Dr. Mark K. Gass, of Sunbury, reported that he had no evidence of carcinoma. He had been cured approximately 18 years.

When the disease has been partially treated by irradiation, and one is dealing with a recurrence in which there is associated a considerable amount of fibrous tissue, the removal by electro-thermic dissection is probably best. I find that when there is much fibrous tissue present, irradiation does not do well until it is carried to the point of producing necrosis. In all such cases, one needs the associated co-operation of both the surgeon and the pathologist, as is indicated by the following case.

Case 4 Male, aged 58 years, was referred by Dr W H Dachtler, of Toledo, on Jan 20, 1913, because of recurrent carcinoma, involving the entire inside of his left cheek, and producing an external epithelioma at the angle of the mouth, approximately 3 centimeters in diameter. The disease had begun about 12 years previously. Ten years previously, the patient had received some x-ray treatment from his local physician, but the disease did not disappear under treatment. Finally, in October, 1911, he consulted Dr Dachtler. Temporarily, the disease seemed to have disappeared under irradiation, but it recurred, and then Dr Dachtler referred the patient to me (Figs 4-A and 4-B).

The patient was given preliminary irradiation to the extent of an erythema dose, with low voltage rays. Then the entire tumor area and cheek extending back to the commissure of the jaw, was removed by electrocoagulation. This was followed by x-ray treatment externally and radium applications made on the inside of the cheek. The treatment was given by fractional doses, keeping it to the point of an erythema dose, at what to-day we would call "saturation value." The patient was treated daily until he had sufficient to cause a moderate grade of atrophy. The details are not given at this time because the technic used at that date is not important at the present time—we have improved very much since then.

Finally, in March, 1914, the wound was closed by plastic operation performed by Dr LaPlace and the patient remained

well for 12 years. On July 9, 1926 he died of angina pectoris, without any evidence of local recurrence.

The ideal method of treatment, and the one that not only gives the patient the least trouble, but will also lead him to come early, because it eliminates the fear incident to operations, is surface applications of radium. The gamma rays of radium, according to my clinical observation, give better results than even high voltage x-ray treatment, though, undoubtedly, good results can be obtained with high voltage x-ray treatment if the treatment is properly given. I believe that in most cases, cancer of the cheek can be treated best by local applications of gamma rays, highly filtered through 2 mm of platinum, and from 1 to 3 mm of rubber, which can be applied about the edges, and over the tumor area on the inside. Externally, radium packs should be applied to the extent of about 50,000 to 100,000 milligram-hours at a distance of 4 cm, using 10 milligram units in 2 mm of platinum, and continuing the applications during a period of three or four weeks, sufficient to produce a definite dermatitis and epithelitis, but not to the extent of producing necrosis externally. This is illustrated by the following Case 5.

Case 5 Male, aged 63 years, was referred on July 18, 1929, by Dr William F Weisel, of Quakertown, Pa. He had an epithelioma growing on the inside of his cheek, about the size of half a dollar, and about one centimeter in thickness. It had been first noticed by the patient six or seven years previously, following the extraction of a tooth. I presume that the tooth which had been extracted was the cause of the local irritation and the extraction simply removed part of the cause, though the patient says that the cheek was injured at the time. He had chewed tobacco during his entire life.

The patient became concerned about the disease because it caused increasing pain. The disease had extended through the cheek (Fig 5-C), and had caused, or, at least, was associated with a lymph node

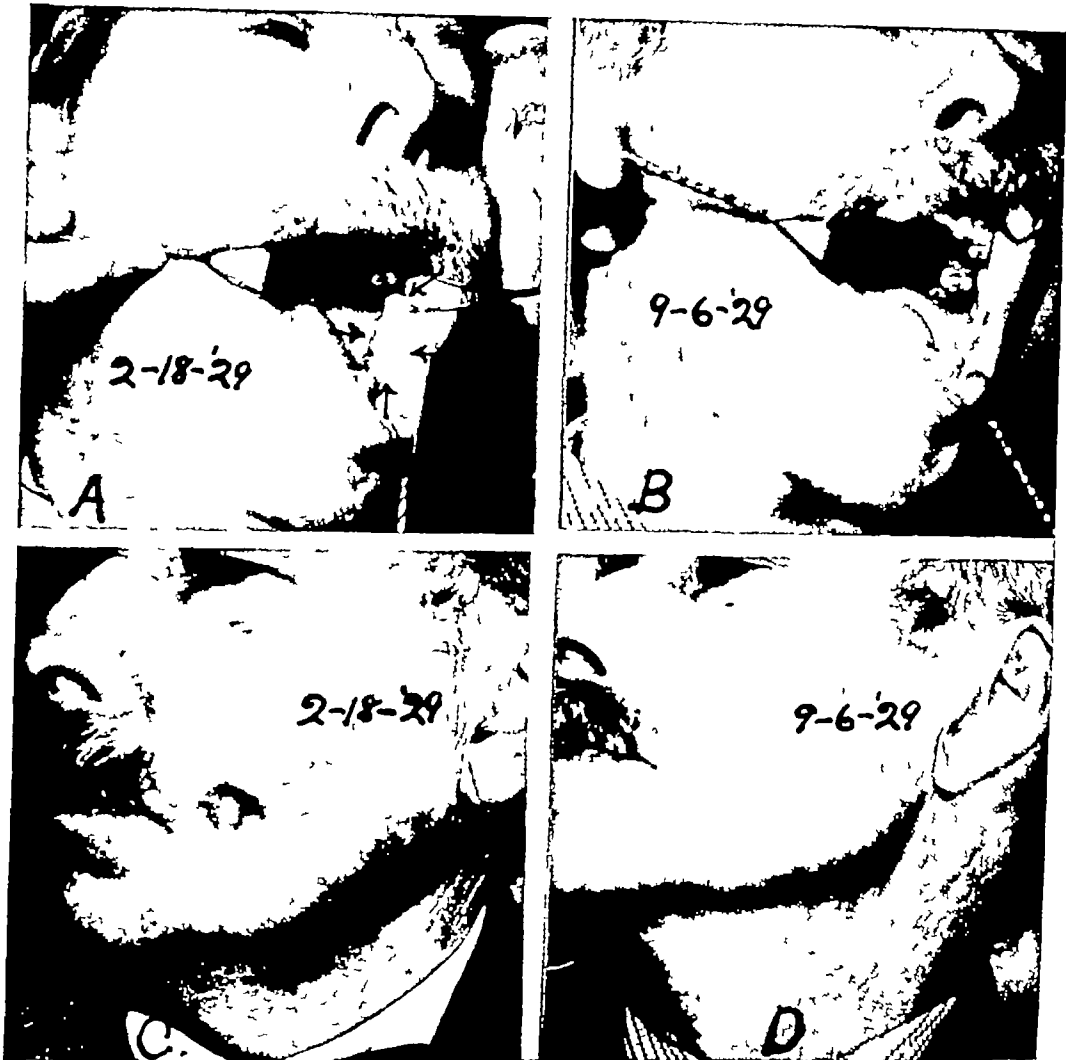


Fig 5 A Case 5 Shows a papillomatous carcinoma (Feb 18, 1929) involving the inside of the left cheek which grew slowly during eight years projecting through the cheek and was associated with metastatic lymph nodes

Fig 5 B Case 5 Shows the tumor entirely gone Sept 6, 1929 The patient is well to-day, five years later

Fig 5 C Case 5 Shows the tumor on Feb 18 1929 extending even through the cheek and associated with an enlarged infiltrating lymph node under the jaw

Fig 5-D Case 5 Shows the disease entirely gone (Sept 6 1929) as well as the dumpling in the cheek, and enlarged lymph node The patient is well to-day

adherent to the jaw, extending into the left submaxillary region, as is shown in the illustration. The microscopic examination showed this to be squamous-cell carcinoma. He was treated on the inside of his mouth with 100 milligrams of radium, in 50 milligram capsules, encased in 2 mm of platinum and 1 mm of rubber. These were applied in three-hour periods, surrounding the edge of the growth, until he

had received on the inside, a total of 2,990 milligram-hours, during a period of two months. During this same period externally, he received by means of radium packs, applied to the left side, 23,737 milligram-hours. The external packs were made up with 10 milligram units in 1 mm of platinum and 1 mm of gold, and applied approximately 1 centimeter apart, but particularly distributed around the pe-

riphery The distance was four centimeters, and the applications were made for the most part during a period of three

"Patient has an epitheliomatous growth about 12 mm in thickness, involving the entire inside of the left cheek, extend-



Fig 6-A

Fig 6 B

Fig 6 A Case 6 Shows the extensive tumor tissue inside the cheek (Jan 20, 1932), of a cauliflower in character, and so extensive that there seemed to be danger of too much surface irradiation doing damage to the normal tissue Therefore after preliminary irradiation inside and outside of the cheek radium needles were inserted

Fig 6 B Case 6 Shows the tumor entirely gone, April 6 1932, approximately six weeks after beginning treatment

weeks, which I consider the most advantageous time for treatment He is well to-day, five and one-half years later

When the disease is very extensive, causing marked thickening of the cheek and locking of the jaws, so that it is practically impossible to make surface applications on the inside of the cheek, it is then advisable to insert the small quantity, dense-walled radium needles for prolonged irradiation, as is illustrated by the following case

Case 6 Male, aged 45 years, referred by Dr C E Brown, of Philadelphia, on Jan 27, 1932, was a laborer in a storage battery factory His smoking, which began at 18 years of age consisted of a pipe and about a package of cigarettes every two days He had noticed a tumor growing on the left cheek, four months previously His jaw seemed "tight," so that he was unable to eat properly He used salt and water as a mouthwash, but did not go to see a physician until two weeks previously On this date, Jan 29, 1932, the following notes were dictated

ing posteriorly to the commissure between the upper and lower jaws It is triangular in shape, the anterior border being about 4 cm, and extending backward into the angle The depth is somewhat uncertain It seemed to have infiltrated the masseter muscle He has several small lymph nodes about 1 cm in diameter, 0.5 cm in thickness, extending below the angle of the jaw In addition to that, there are a group of small lymph nodes only a little bigger than a grain of wheat, extending down along the anterior border of the sterno-cleido-mastoid, traceable to within about 3 cm above the clavicle

"The patient is to have a cast made lengthwise, covering the entire left side of the neck and supraclavicular region The left side is to be carried to a point 2 cm above the zygoma, and the radium is to be carried up as high as the zygoma and down as far as the level of the clavicle, 200 mg on the left, and 100 mg on the right The radium on the right side is to be in the form of a disc Eight such ap-

plications are to be made within three weeks' time, in 24-hour periods. It would be advisable for him to make arrange-

On April 6, 1932, the following notes were dictated: "There is no visible or palpable evidence of disease inside or out-



Fig 6 C

Fig 6 C Case 6 Shows an anteroposterior view giving the distribution of the radium needles



Fig 6 D

Fig 6 D Case 6 Shows the lateral view. This suggests that the needles may have been put in at random but they are in different layers and are so arranged as to give a uniform distribution of the irradiation throughout the palpable tumor tissue. In addition to this the patient received external irradiation and is well to date.

ments to-day with his employer, and to come into the hospital to-morrow morning, if there is a bed available, for Saturday and Sunday. Since the treatment cannot be started until February 3, the patient is to have, on the days preceding, four 25 per cent doses of high voltage x-rays carried through the back of his neck toward the inside of his left cheek, 2 mm copper filter. Radium is to be applied after the preliminary x-ray treatment. Specimen of tissue is to be removed on February 5, and six 4-cm 2-mg radium needles are to be inserted on Friday, February 5, to remain in place five days."

On Feb 5, 1932, the following notes were dictated: "Tumor on the inside of the cheek seems to have been reduced probably 20 per cent. Specimen was removed which was reported by Dr Eugene A Case, as squamous-cell carcinoma. Eight 2-mg radium needles, 44 mm in length, were inserted into the skin of the cheek, four from below upward, four from the anterior surface toward the posterior surface, and two under the left angle of the jaw."

side the mouth, and no break in the mucous membrane. The patient still has total alopecia in the occipital region, and back of neck. He is continuing with his job as a janitor at the Storage Battery Co." On April 9, 1932, Dr Brown reported: "This morning, the patient whom you have been treating for a growth in the mouth, came to the hospital and showed us the result of your work. Dr Robert Shoemaker saw him with me and believes with me that you have attained a beautiful result. His mouth is in much better condition at present than we could have hoped for, and all that remains to palpation is a small indurated area at the site of a former cauliflower, fleshy, walnut-sized growth."

The patient did not keep appointments but returned on Aug 10, 1932, at which time the examination showed no visible or palpable disease. Infected teeth had not been removed. On Oct 19, 1932, examination showed no visible or palpable disease, the patient being able to fully open his mouth at this time. On Jan 4,

1933, and again on April 5, 1933, no visible or palpable disease could be seen. On June 7, 1933, and Dec 7, 1933, the patient was well.

On Feb 4, 1932, his blood showed the following: hemoglobin, 67 per cent, red blood cells, 4,500,000, white blood cells, 6,100, polymorphonuclears, 56, large lymphocytes, 38 per cent, monocytes, 3, basophils, 2, eosinophiles, 1. The serologic tests, both the Kolmer and Kahn, were negative. The blood sugar, taken on Feb 4, 1932, was 126, the blood urea was N 13, and blood CO_2 , 58.

A radium pack, containing 200 milligrams of radium, was applied, on February 4, to the left side of the neck at a distance of 4 cm, fastened to a wax mold, and the additional distance was made up with felt. At the same time, 100 milligrams was applied to the right side, for a period of 30 hours, making 7,200 milligram-hours. An additional radium pack was applied for 24 hours, on Feb 10, 1932, 200 milligrams on the left side, making a total of 4,800 milligram-hours. On Feb 5, 1932, ten 2-mg needles were inserted into the left cheek and angle of jaw, needles being 4 cm in length, making a total of 2,334 mg-hours.

X-ray treatments were given through the right side of the neck over a 10×18 cm field, using 200 K V, 2 mm of copper filtration, 25 per cent of erythema dose. A treatment of 250 r was given on the following dates: Feb 11, 12, 18, March 3, 8, 12, 17, 22, 1932. In the left post-auricular region, cross-firing on the deeper part of this growth, similar treatments were given on the following dates: Feb 13, 16, 24, 29, March 5, 10, 15, 19, 1932.

On Nov 21, 1934 a telephone report from the company for which the patient is working reported that he is well, and able to work every day in the power plant.

DISCUSSION

It will be seen that cancer cannot be treated by rule, but that each case must

be treated according to the conditions present.

I believe that the failures in the treatment of carcinoma of the cheek are due primarily to insufficient treatment or at least, to insufficient deep radiation therapy. For a long time, this group of cases has been giving unsatisfactory results. When the disease is caused by the irritation from tobacco or syphilis, one must realize that the damage done to the mucous membrane is not confined to one cheek. I have seen a number of cases in which the primary lesion was cured in one cheek, and the patient then developed a similar disease in the opposite cheek, which must be expected if the same primary conditions are present.

Generally speaking, I believe that prolonged and more or less continuous irradiation with gamma rays will give the best results, because these lesions are generally of the slowly growing type, therefore, relatively resistant to irradiation. That type of tumor requires a prolonged irradiation, which can be given by surface applications in the early cases, using preferably 2 mm of platinum filtration, and giving approximately 2,000 to 3,000 milligram-hours on the inside of the cheek. Also by means of radium packs, giving from 50,000 to 100,000 milligram-hours externally at a distance of 4 centimeters.

It is my aim in the treatment of these cases to bring about an epithelitis and radiodermatitis, within a period of about two weeks, and then to retain this effect by additional dosage, during a period of about two weeks longer. In the bulky tumors the insertion of radium needles into the tumor tissue, using 0.5 or 0.6 mm of irridio-platinum filtration, and using needles containing 1, 2, or 3 milligrams, according to the length needed, to distribute the irradiation over the tumor area, should give the best results.

In conclusion, I would urge, however, that the most important treatment of cancer of the cheek is the elimination of the cause, and the thorough, and complete destruction of the precancerous lesion.

CASE REPORTS AND NEW DEVICES

A SIMPLE METHOD FOR ESTIMATING LOSS OF r UNITS FOLLOWING X-RAY TREATMENT¹

B. WILLIAM J. YOUNG, M.D. and JESSIE HILL LOVE, M.D., Louisville, Kentucky

The explanation of the difference of sensitivity of cancer cells to irradiation will prove a great aid for our attack upon them, but at present this is not satisfactorily understood. There are so many other problems that we feel a certain amount of satisfaction in presenting a chart which we have found to be of aid in computing loss of x -ray units, with exactness. With saturation technic, we have found the chart especially useful, owing to the necessity of maintaining the saturation dose over a period of three weeks. The dose over each portal of entry must be computed separately so that one may estimate the combined effective number of roentgens which shall be received by the skin to complete its 800 effective roentgens.

The chart shown in Figure 1 may be used either for finding the actual percentage of r lost over any period of time, or the remaining number of r which are still effective after the loss has been deducted. The various lines have been drawn in to mark off the several divisions.

The row of figures above the line EF indicates any dose of r units that is effective at any time during the course of treatment. The percentage of loss of x -ray energy is shown by the per cent column to the right of the line GH, while the units remaining after the loss has been deducted are determined by referring to the per cent column to the left of the line BC.

¹ Received for publication June 26 1934

For example, if a dose of 1,700 r has been given, and, at the end of four days, there is a loss of 20 per cent, or 340 r , the result is found on the chart by following the line opposite the "20 per cent" in the column to the right of the line GH to the figure in the column under 1,700—the dose given. (Arriving at effective percentage in a course of treatment, keep each treatment to date and finish with 800 units effective.)

To find the effective units remaining, use the "20 per cent" in the column to the left of the line BC. The answer is 1,360, as shown under 1,700—the original dose. Note that the above example is taken because it is easy to follow. Our effective dose is 800 r units, the tolerance dose to the skin.

The same procedure may be followed to find the loss and the effective r units remaining for any dose shown on the chart.

The method of demonstrating the chart in cases in which the complete portal is irradiated is as follows. Usually, each portal is given one-third or one-half a skin dose at a treatment, carried out on successive days, rotating to the different portals. The daily loss, for example, averages 5 per cent.

EXAMPLE

	r given	Total r	Effective r	r loss
June 1, Portal A	350	350	350	52
2 Portal B				
3, Portal C				
4 Portal A	350	700	648	

On June 1, 350 r delivered to Portal A would give 350 r effective on that same day. Portal A is to be irradiated three days later, there-

B		0%																							
		1700	1650	1600	1550	1500	1450	1400	1350	1300	1250	1200	1150	1100	1050	1000	950	900	850						
E	5	1615	1567	1520	1472	1425	1377	1330	1282	1235	1187	1140	1092	1045	997	950	902	855	807						
	10	1530	1485	1440	1395	1350	1305	1260	1215	1170	1125	1080	1035	990	945	900	855	810	765						
	15	1445	1402	1360	1317	1275	1232	1190	1147	1105	1062	1020	977	935	892	850	807	765	722						
	20	1360	1320	1280	1240	1200	1160	1120	1080	1040	1000	960	920	880	840	800	760	720	680						
	25	1275	1237	1200	1162	1125	1087	1050	1012	975	937	900	862	825	787	750	712	675	637						
	30	1190	1155	1120	1085	1050	1015	980	945	910	875	840	805	770	735	700	665	630	595						
	35	1105	1072	1040	1007	975	942	910	877	845	802	780	747	715	682	650	617	585	552						
	40	1020	990	960	930	900	870	840	810	780	750	720	690	660	630	600	570	540	510						
	45	935	907	880	852	825	797	770	742	715	687	660	632	605	577	550	522	495	467						
	50	850	825	800	775	750	725	700	675	650	625	600	575	550	525	500	475	450	425						
	55	765	742	720	697	675	652	630	607	585	562	540	517	495	472	450	427	405	382						
60	680	660	640	620	600	580	560	540	520	500	480	460	440	420	400	380	360	340							
65	595	577	560	542	525	507	490	472	455	437	420	392	385	367	350	332	315	297							
70	510	495	480	465	450	435	420	405	390	375	360	345	330	315	300	285	270	255							
75	425	412	400	387	375	362	350	337	325	312	300	287	275	262	250	237	225	212							
80	340	330	320	310	300	290	280	270	260	250	240	230	220	210	200	190	180	170							
85	255	247	240	232	225	217	210	202	195	187	180	172	165	157	150	142	135	127							
90	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85							
95	85	82	80	79	75	72	70	67	65	62	60	57	55	52	50	47	45	42							
100%		17	16	4	16	15	4	15	14	4	13	12	4	12	11	4	11	10	4	10	9	4	9	8	4
C																									

Fig 1 This chart is reduced from the master chart used by us in our treatments. If it is found

fore, would incur a loss of 15 per cent, or 52 r (Using chart, the 15 per cent in the column on the right is followed over to the figure in 52 column under 350—the three-day loss) The 52 r are then subtracted from 700, the total dose on June 4, giving 648 r effective on June 4 Portals B and C receive the same doses, at the same intervals between treatments, and the same calculations The method is continued until an effective dose of 800 r has been given all portals The chart is again used to calculate the weekly loss to be given back to the patient

CONCLUSIONS

1 The accompanying chart (Fig 1) offers a simple means of obtaining loss, or the present amount of r units in a given portal

2 One is thus enabled to give single or fractional doses and remain within the line of safety

3 It is especially useful in treatments involving many portals, which necessitate complex arithmetical computations

Brown Building

FRACTURE OF THE DORSUM SELLA¹

REPORT OF A CASE

By M LOWRY ALLEN, M D, Philadelphia
Radiologist, Episcopal Hospital

A review of the literature fails to reveal the report of a single case of fracture of the dorsum sella However, in this age of frequent head injuries due very frequently to the automobile, it probably occurs occasionally and no doubt

¹ Accepted for publication Nov. 26, 1934

has been previously seen by surgeons and roentgenologists, who have failed to report the finding In view of the unusual nature of the injury, I feel that the following case should be reported

H B, white male, aged 39 years, was admitted to the Episcopal Hospital on the surgical service of Dr Edward T Crossan, on Nov 5, 1933, following an automobile accident On admission the patient was gasping for breath, bleeding from the left ear and nose and mouth, and was in extreme shock Thirty minutes after the institution of shock therapy the patient began to react favorably, the pulse coming down to 100

Physical Examination—The patient was a robust, adult white male, lying quietly in bed, breathing regularly, and entirely co-operative There was a laceration of the right parietal region which had been sutured in the Receiving Ward The right pupil was larger than the left, and both pupils reacted well to light There was dried blood in both nostrils, in the left ear, and also on the tongue The heart and lungs were negative The biceps reflex on the right was less active than on the left The blood pressure was 76 systolic and 50 diastolic

Roentgen Examination—Roentgenologic examination (Fig 1) revealed a linear fracture beginning in the left parietal bone and extending forward and downward into the squamous portion of the left temporal bone, continuing into the base, and involving the petrous portion of the left temporal bone In addition there was a fracture of the base of the dorsum sella, with backward displacement of this structure and the attached posterior clinoid processes

Clinical Course—During his sojourn in the hospital the patient's general condition progressively improved On Nov 7, 1933, an

800	750	700	650	600	550	500	450	400	350	300	250	200	150	100	40	30	20	10	5	0	100%
760	712	665	617	570	522	475	427	380	332	285	237	190	142	95	38	28	19	F			95
720	675	630	583	540	495	450	405	360	315	270	225	180	135	90	36	27	18		4	5	90
680	637	593	552	510	467	425	382	340	297	255	212	170	127	85	34	25	5				85
640	600	560	520	480	440	400	360	320	280	240	200	160	120	80	32	24		8	4	0	80
600	562	525	487	450	412	375	338	300	262	225	187	150	112	75	30	22	5				75
560	523	487	450	415	380	345	310	275	240	205	170	135	100	65	28	21		7	3	5	70
520	483	448	415	380	345	310	275	240	205	170	135	100	65	30	22	5	13				65
480	440	400	360	320	280	240	200	160	120	80	40	0	0	0	24	18	12	6	3	0	60
440	400	360	320	280	240	200	160	120	80	40	0	0	0	0	22	16	5	11			55
400	375	350	325	300	275	250	225	200	175	150	125	100	75	50	20	15	10	5	2	5	50
360	337	315	292	270	247	225	202	180	157	135	112	90	67	45	18	13	5	9			45
320	300	280	260	240	220	200	180	160	140	120	100	80	60	40	16	12		4	2	0	40
280	262	244	227	210	192	175	157	140	122	105	87	70	52	35	14	10	5	7			35
240	223	210	195	180	165	150	135	120	105	90	75	60	45	30	12	9		3	1	5	30
200	187	175	162	150	137	125	112	100	87	75	62	50	37	25	10	7	5				25
160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	8	6	4		2	1	20
120	112	103	97	90	82	75	67	60	52	45	37	30	21	15	6	4	5	3			15
80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	4	3		2	1	0	10
40	37	33	30	27	25	22	20	17	15	12	10	7	5		2	1	5	1			5
8	7	4	7	0	4	6	5	4	4	3	4	3	2	4	2	1	4	1			0%

of assistance the authors will be glad to supply reproductions of the original chart at a nominal cost.

ophthalmological examination by Dr Andrew Knox revealed the following O D, partial paralysis of the external rectus The pupils

O S, same as O D, except for slight ptosis of the lid

A neurologic examination, performed by Dr

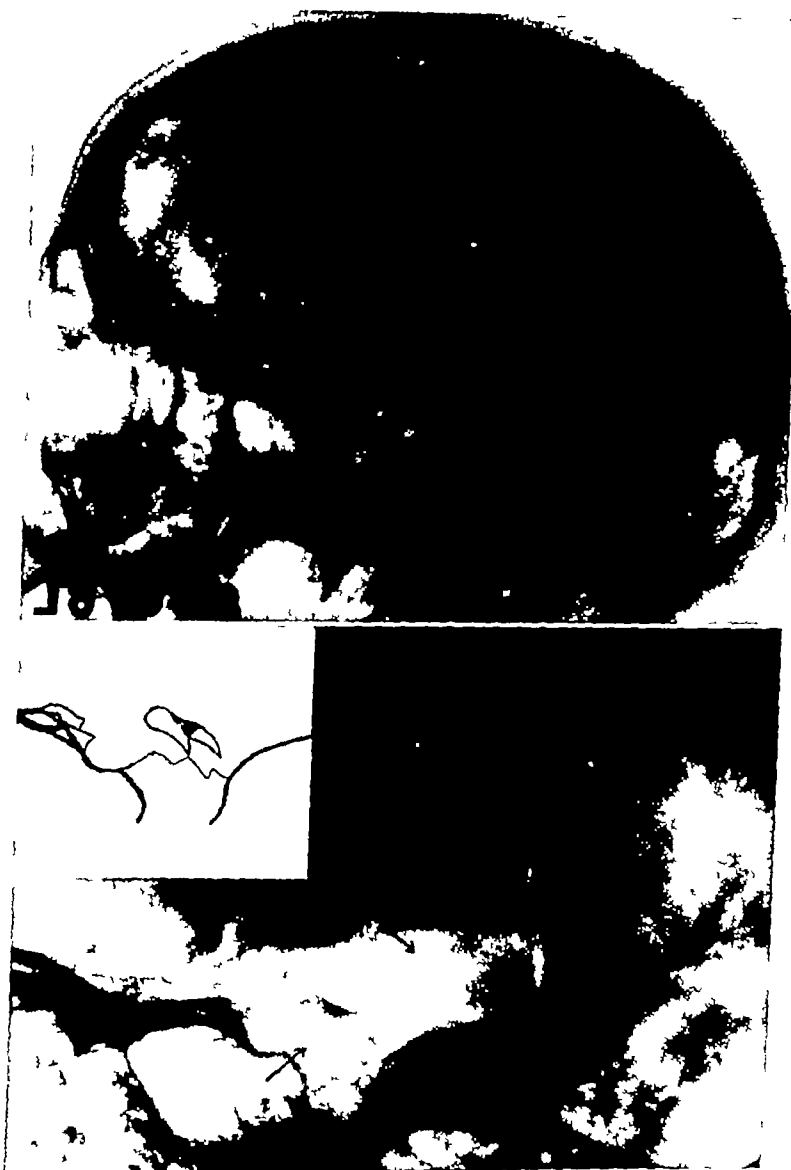


Fig 1 (*above*) Roentgenograms made on admission to the hospital showing linear fracture of left parietal bone and squamous portion of left temporal bone. The fracture of the dorsum sella is well shown with backward displacement of this structure

Fig 2 (*below*) Roentgenogram made three months after injury. The dorsum sella still shows rather marked posterior displacement

were dilated with homatropine. The medium was clear. The outline of the nerve head was sharply defined. There was much physiological cupping noted. The veins were injected and the nerve head was quite pale.

Samuel Hadden on Nov 7, 1933, showed the left palpebral fissure to be narrower than the right, also, there was definite paralysis of the right external rectus muscle. The right side of the face was not as well innervated as the left.

The tendon reflexes were normal except that the right patellar reflex was a bit more active than the left. On Nov 9, 1933, a lumbar show posterior displacement of the dorsum sella, with no demonstrable evidence of bony union occurring. There is some slight blurring

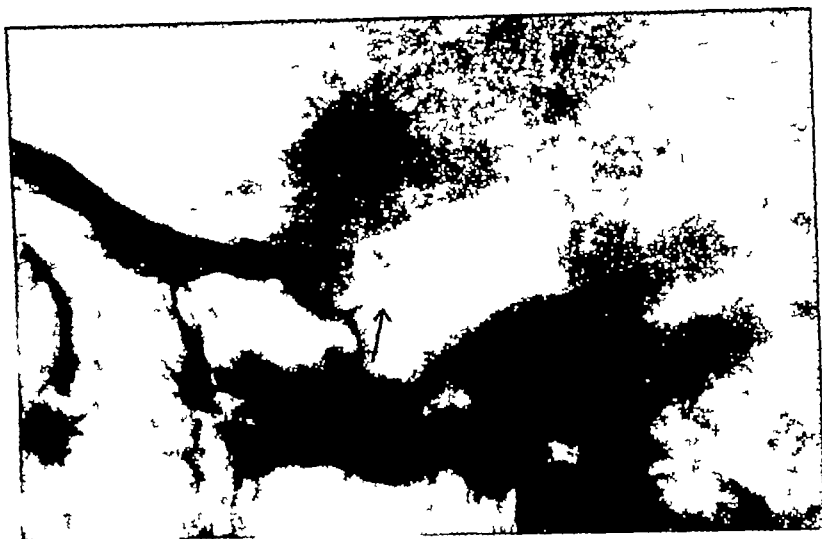


Fig 3 Roentgenogram made ten months after injury. The dorsum sella is still displaced posteriorly and shows moderate rarefaction probably representing the beginning absorption.

puncture was done. The spinal fluid was under a pressure of 10 mm of mercury, and 5 c.c. of bloody fluid were removed. Many red blood cells were present in the specimen. The blood Wassermann was negative. The blood urea and blood urea nitrogen figures were within normal limits. The blood count showed the following, R B C 4,220,000, W B C 11,360, Hgb 80 per cent. Urinalysis was negative.

The patient was discharged in good condition on Nov 23, 1933, except for a paralysis of the right external rectus muscle. On Feb 8, 1934, the patient was seen again and found to be in good physical condition except for a residual paralysis of the right external rectus muscle. The roentgen examination (Fig 2) at this time showed little change in the appearance of the lines of fracture, and the dorsum sella was again noted to be displaced posteriorly. The patient came in for a final check up on Sept 21, 1934, over 10 months after the original injury. He again manifested a complete paralysis of the right external rectus muscle, stating that in his employment as a punch drill operator he was compelled to do his work with his right eye closed, as he had double vision when he used both eyes, particularly on looking to the right. However, he felt well in every way, being able to work steadily at his usual employment. There were no symptoms of pituitary dysfunction. Roentgenograms made at this time (Fig 3) again

in the outline of the fractured dorsum sella and some rarefaction present in this structure, which findings may be indicative of the beginning absorption of the fractured fragment.

Comment—It is interesting to speculate as to the mechanism involved in the production of such a fracture. In company with Dr O. V. Batson, Professor of Anatomy in the Post Graduate School of Medicine of the University of Pennsylvania, the writer examined several wet and dried skulls in search for an explanation of the involved mechanism. This examination seemed to point to the following most likely mechanism. At the moment of impact by the facturing force, the contour of the cranial vault was momentarily altered to such a degree as to result in an elongation of the normal anteroposterior diameter of the skull, thus exerting marked stretching and tension on the free margin of the tentorium cerebelli and the petro-clinoid ligaments. Since these structures are attached to the dorsum sella, a sufficient sudden tautness of them would probably result in fracture and backward displacement of the dorsum sella. The injury to the patient's sixth nerve is explained by the close proximity of this structure to the lateral aspect of the dorsum, in which location the sixth nerve lies in a definite groove on the lateral surface of the dorsum sella.

Conclusion—A case is reported of fracture of the dorsum sella, followed by recovery.

The apparent rarity of this injury is probably explained by the fact that when it does occur, the associated cranial injuries are of sufficient severity to result in the immediate death of the patient

COLONIC LESION

By W H McGUIFIN M D, *Calgary, Canada*

Case No 5,634 G A, aged 58 years, male, married, by occupation a music teacher. The patient, who was first seen by Dr A B Singleton in June, 1930, complained of periodic attacks of weakness generally following a movement of the bowels, after which there would be a small quantity of blood passed. He also complained of occasional slight diarrhea, slight distention, and some borborygmus. Otherwise, his general health was good.

This condition continued and in April, 1932, a radiologic examination was conducted of the gastro intestinal tract. Nothing of importance was discovered except at the junction of the pelvic and iliac sections of the colon where we noted a slight irregularity. There was no palpable mass and very little tenderness. After evacuation of the barium enema, air was injected and an intraluminal mass was discovered, also, multiple diverticula scattered throughout the course of the colon.

No treatment of a radical nature was instituted. The patient's health remained good.



Fig 2 Photograph of the section of bowel excised demonstrating the papilloma (Photograph taken by Mr E S Hoare)



Fig 3 Drawing, by Miss B Forcade of mass demonstrating the ulcer at the base of the papilloma, with malignant growth in the wall of the bowel underlying the ulcer



Fig 1 The colon, following a double contrast enema—intraluminal mass junction of pelvic with iliac sections of colon—small amount of barium adherent to the mass. Examination April 1932



Fig 4 Barium enema examination of colon, deformed shadow at the junction of pelvic, with iliac colon exhibiting evidence of thickening of the walls with encroachment upon the lumen. Examination July, 1934

although the periodic weak spells continued, with loss of blood after each movement.

In July, 1934, sigmoidoscopic and radiologic examinations were conducted. The sigmoidoscopic examination revealed negative findings

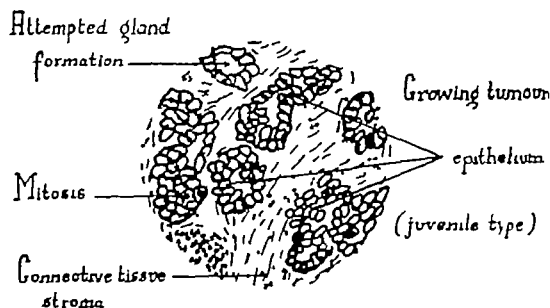


Fig 5 Sketch of pathologic section by Dr Lola McLatchie, demonstrating the type of cells

except for a slight degree of injection of the walls of the upper rectal and lower sigmoid colon. The radiologic examination revealed evidence of a deformity indicative of increased bowel area involvement which lead us to the conclusion that there was, in addition to the intraluminal mass, bowel wall involvement.

Blood and urine analyses were normal. Wasserman test was negative.

Surgical intervention by Dr W. A. Lincoln

revealed a moderately large papilloma of the sigmoid colon and some thickening, with ulceration of the bowel at the base of the papillomatous mass. Four inches of bowel were resected. A rectal tube was inserted *via* the anus past the suture line and retained. A cigarette drain was introduced.

The patient has made an uneventful recovery and is now enjoying splendid health.

Pathologic Report by Dr J. J. Ower—Specimen from sigmoid colon. Gross: Piece of bowel six centimeters long. From the mucous membrane protrudes a pedunculated papilloma of mulberry type, roughly one and one-half centimeters in diameter, stalk being two centimeters in length.

Beside the base there is an indurated shallow ulcer two and one-half centimeters in diameter. At both edges of the base of the ulcer, there is situated a mass of firm yellow tissue, obviously malignant.

Microscopic examination of the growth at the base of the ulcer showed a localized infiltration of the intestinal wall by irregular masses of rapidly growing epithelium of juvenile type, with areas of attempted gland-formation. There were a moderate number of mitotic figures.

Pathologic diagnosis revealed an adenocarcinoma of the ulcer at the base of the benign pedunculated papilloma.

EDITORIAL

LEON J. MENVILLE, M.D., Editor

HOWARD P. DOUB, M.D., Associate Editor

THE RADIOLOGIST AS PHYSICIAN¹

At the recent meeting of the British Medical Association at Bournemouth, Dr. Le Fleming, speaking from the general practitioner's point of view on the value of radiology in diagnosis and treatment, advocated a more close and personal contact between the radiologist and the family doctor. He said that the present relationship fell somewhere midway between the ideal of the medical consultation and the more remote pathologic report. He added the ominous opinion that the trend of affairs was, on the whole, away from that personal contact which he advocated.

If Dr. Le Fleming is correct in this view—and I am afraid there is truth in what he says—then I venture to say it is a bad thing for radiology and for medicine in general.

Laboratory Diagnosis in Radiology—The term "laboratory diagnosis" may be applied to any method which does not call for personal examination of patients. There can be no doubt that a large part of radiodiagnosis as carried out at hospitals comes within this definition. There is no essential difference between the radiologic report on a film and the pathologic report on a microscopic slide.

This tendency toward laboratory diagnosis in x-ray work was not at first evident. In the early days of x-rays the man unquestionably dominated the machine. Many of the pioneers, such as Williams, of Boston, were distinguished physicians before they devoted themselves to the new method, and, the fact that radiography of moving organs was then impossible made screen work by the physician essential for the chest and alimentary tract. X-rays were at first largely aids to direct clinical examination, and were employed by persons who continued to rely to a great extent on older and well-tried clinical methods.

With the increasing power and complexity of apparatus there arose a new type of radiologist, who was often attracted to the specialty solely because he had a liking for mechanics.

The machine began to dominate the man. The first object became, in a literal sense, the production of "more, bigger, and better" radiographs. The 12 × 10 in. film gave way to the 15 × 12, and this to still larger sizes. Speed and definition increased at the same time. The second object was to interpret the films. The "direct evidence" school, as opposed to the continental school which believed in diagnosis by symptom complexes, no doubt made radiodiagnosis more nearly approach an exact science, but, at the same time, tended to divorce it from clinical medicine. The slogan "show it to me on a plate" served a useful purpose, so long as new findings were being continually demonstrated, interpreted, and classified. But inevitably there came a slowing-down of this process. The work of exploring and charting the mountains, rivers, and oceans of this new country came to an end, and there now remain only remote streams and valleys where the explorer may still find something new. To leave aside metaphor, 99 out of every 100 films seen in an average day's work in the radiodiagnostic department of a large hospital can be interpreted according to a well-established routine. I have no hesitation in saying that an intelligent person occupying the post usually referred to as "sister x-rays" could, after a few years' experience, almost replace the radiologist so far as the actual reading of films is concerned. The illness of my junior once compelled me to accept a suggestion of the sister-in-charge that, to save time, she should write reports in advance, leaving it for me to read and sign them only. It was a humbling and a chastening experience which I can recommend to anyone who may suspect himself of spiritual pride. I do not, of course, mean to suggest that an x-ray department could be run in this fashion indefinitely, but if we think of an out-patients' department in charge of a competent physician, it is impossible to imagine its being carried on with any degree of efficiency even for a single day without him.

An All-round View of the Patient—Con-

¹ Presidential address to the section of radiology of the Royal Society of Medicine on Oct. 19, 1934. Reprinted by permission of the author.



LLOYD BRYAN M.D. of San Francisco, President of the Radiological Society of North America

siderations such as the above tend to show that the radiologist must beware lest he become a mere interpreter of film images, no matter how skillful. That he should see all the patients in a crowded hospital department is a manifest impossibility, but he should personally examine chest patients and alimentary-tract cases, and so far as the exigencies of a busy life permit, attend operations and visit the post-mortem room. When he cannot do this, he should adopt some method of being kept informed as to the results.

It is to be hoped that the time will never come, although there are some who visualize it, when there will be no private practice in radio diagnosis. For it is in private practice that the radiologist has the greatest opportunity to let the physician which is in him—or which, at any rate, *ought* to be in him—live for a time on equal terms with the specialist. Let him carefully take the histories of all his patients, and he will not seldom hear things of importance which have not been elicited by anyone else. For it is a fact that, apart from neurasthenics who have their whole case written out on paper, patients will rarely give precisely the same history to two different men.

The history may suggest that a patient who has been sent for examination of the alimentary tract is in reality suffering from some trouble in the chest—or *vice versa*. It is, of course, the duty of the radiologist to carry out the examination requested, as to what he should do in addition, he must use judgment and tact. I recall upon an occasion many years ago being asked to examine the lungs of a patient for tuberculosis, as he was very breathless. It was at once evident on screen examination that the trouble was cardiac. I reported to this effect, and was told by the doctor concerned that "he wanted a 'picture' of the patient's lungs, and would I please mind my own business as regards his heart." Such an attitude is now fortunately rare, but not wholly unknown. Its absurdity is evident when we consider that it is equivalent to sending a patient to a consulting physician with a request to palpate the abdomen, but on no account to put a stethoscope on the chest.

The arts of inspection, percussion, and palpation should never be lost. Inspection may show a hitherto unnoted skin nodule, a patch of pigment, a forgotten operation scar, an area of pulsation, or some other valuable guide as to what should be particularly looked for in the

radiographic examination. The necessity of palpation in conjunction with the opaque meal or enema hardly needs emphasizing, but the finding of an enlarged spleen may give the clue to an unexplained hematemesis or melena.

The practitioner who resents the radiologist taking an all-round view of his case, will eventually drift to someone who gives him exactly the kind of radiologic service he deserves. If he alone were concerned, that would be of little consequence. But it is hard on his patients, and therefore the psychology of the matter is worth considering. I think that subconsciously his mental processes are something like this: "Except in the reading of x-ray films this man is no more competent than I am to deal with this case, and his doing some of the things which I have already done, or could have done lets me down in the eyes of my patient." Note that the same man does not resent the consulting physician palpating a case that he himself has already palpated, or feel humiliated if something is discovered which he has missed. This brings us to a very important point. If the diagnostic radiologist wishes to hold his own in the future—if he wishes to remain a free-swimming organism, and not settle down to a sessile stage in the confines of a laboratory—he must be as highly qualified as the consulting physician. As a young man he should seek house appointments where extremely valuable general experience can be found, and should take a higher medical qualification either before or after, but preferably before, taking one of the special radiologic diplomas. I have noted of late a tendency to regard a higher medical qualification as essential for certain radiologic appointments. It is an excellent innovation and should be encouraged by radiologists as a body.

Then there is the question of all-round knowledge of a special subject. For instance, a new form of comparative pathology is called for. It is not enough for a man to know the radiographic appearance of certain diseases; he should be equally familiar with these diseases in their clinical and pathologic aspects. This ideal has been lived up to by some, and the appointment of a radiologist as Hunterian professor at the Royal College of Surgeons is a good omen for the future.

An All-round View of Medicine—There is yet another reason why it is of extreme importance that radiologists interested in diagnosis should keep in touch with medicine as a whole

Diagnostic radiology to day is in much the same position as surgery—it is unlikely to make any great advance unless helped by some extraneous discovery. In the sixties of the last century surgeons had conceived, and in many cases attempted, most modern operations, but sepsis continued to defeat them. Then came Pasteur, a chemist, with his work on fermentation, and Lister, a practising surgeon. Such a combination is essential. Had Lister confined himself to acquiring technical skill as a surgeon, he might never have heard of Pasteur's work, much less applied it, and so made possible the surgery of to-day. Similarly we need radiologists who are always alert to apply discoveries in other fields.

The gall-bladder demonstrations which we are now able to carry out are not the result of direct investigation. The study of the concentration of certain compounds in the gall bladder was begun as a biochemical research. But it occurred to a radiologist who knew of these experiments that the substitution of bromine or iodine for chlorine in the formula might result in the concentration in the gall bladder of a substance opaque to x-rays. Cholecystography and intravenous pyelography are the only advances in radiodiagnosis which were not foreseen by one or other of the early workers. In a book published by Williams, of Boston, in, I think, 1899, you will find practically everything else referred to, notably instantaneous radiography and opaque meal examinations. At the moment nothing appears on the horizon except elaboration of existing processes. Let us pray for a biochemist to discover something of value to us, and for a radiological Lister capable of seizing upon the discovery to lighten our darkness.

The Specialty of Method Its Limitations and Dangers—Now, if it is important for those of us who practise diagnosis to be physicians before we are radiologists, it is, if that be possible, a matter of even greater moment for those who profess and call themselves therapists. To paraphrase slightly a well-known jibe, the time has gone by for complacently pouring rays of which we know little into a body of which we know nothing. So far, radiotherapists have shared with surgeons the unique distinction of being specialists in a method. They have reached their present none too secure position because therapeutic apparatus has been continually advancing in power, and because technic has been in a fluid

state. But there are now signs of stabilization, and the modern dosimeter has made it safe for lay assistants to apply routine prescriptions. Radiotherapists who are inclined to be complacent, should study the history of electrotherapeutics in this country. A decade ago it reached the stage of standardization, from that time onward it has passed more and more into lay hands. The medically qualified man who confined himself to carrying out the actual technic of electrotherapy has been crowded out, with few exceptions, only those who have established themselves as physicians interested in a class of diseases known to be benefited by electrotherapy have survived. I fear for radiotherapists a similar extinction unless, like the wise men just referred to, they take steps to consolidate their position.

There are three possible forms of specialization in medicine.

(1) There is the specialty of method, as exemplified by the surgeons, also to some extent by the vaccine therapists, electrotherapists, radiotherapists and one might perhaps add the osteopaths.

(2) There are the regional specialties—the eye, the ear and throat, urinary system, etc. The ophthalmologist, the laryngologist, the urologist, the gynecologist are concerned with a particular set of organs, and consider themselves free to use any method of treatment which seems to them good. Many are fellows both of the College of Physicians and the College of Surgeons, the limitations which custom imposes upon them are topographical, not therapeutic.

(3) There are specialists connected neither with therapeutic methods nor with particular regions of the body, but with diseases as such. Experts in tuberculosis in rheumatism, and in tropical diseases are examples.

It is with the first and third categories that radiologists should concern themselves. There is so far no instance of a "specialty of method" pure and simple having survived. If surgery be instanced, it can at once be pointed out that it survives because it invades the third group—namely, that of specialties in particular diseases. That some surgeons fully realize this is evident from their publicly expressed opinions. All radiotherapists should read the address given by Mr. Geoffrey Keynes to the Royal Medical Society of Edinburgh in February last, on the Future of Surgery (Lancet, 1934, 1, 1043). Speaking of cancer he said:

"So large a proportion of surgical activity is taken up with cancer that its removal from the sphere of surgery would cause an enormous hole in the surgeon's day. Moreover it appears to me that if this is ever to happen at all it will happen suddenly. The cancer problem is partly a biochemical one and the process of

experimental cancer production is so nearly perfected that the successful reversal of the process may not be so far distant as we are often inclined to suppose. Surgery can often deal successfully with the primary cancerous growth when it is accessible. *It is by the inaccessible parts of the disseminated disease that we are so constantly defeated* [Ita lies mine.] Cancer disseminates by the circulation, whether it be by blood vessels or lymphatics and perhaps it is by the same route that it will ultimately be attacked particularly if a biochemical cause leads to the discovery of a biochemical cure.

Such is Mr. Keynes's vision of the future, and I think few will disagree with him. Note, however, the consolation which he proceeds to offer to his colleagues. He says "Those surgeons who are sufficiently adaptable may be able to add the biochemical method to their repertory, for after all it will still be the surgeons who will make the diagnosis and have much of the responsibility for the treatment of the patients." A little later in his address, however, he seems to have had doubts about the matter, for he says, speaking of the advance of radiotherapeutics "This process of encroachment will not stop, and perhaps in the end it will be the radiologists and not the surgeons who will receive the rudest shock from the cry that 'cancer is conquered'."

Now, while it may in some cases be inevitable, it is on the whole, a bad thing for any body of medical men to be wholly dependent upon a single method of treatment. Human nature being what it is, such a state of affairs may conceivably clog the wheels of progress. I suggest to the younger radiologists who are interested in therapy that they should concentrate on those diseases in which radiotherapy constitutes the chief, or at any rate a very important part of their treatment. Cancer of the breast is an excellent example. I think unbiased observers must admit that in this condition radiation is now of an importance at least equal to that of surgery. It should therefore be the aim of radiologists to become the leading authorities on the disease. They will not attain this position by concentrating on the precise means by which to apply x-rays or the radium "bomb," any more than surgeons reached their standing solely by skill in the performance of the radical operation. In the past, surgical writings have been the source of practically all that is known of breast cancer—its etiology, pathology, diagnosis, and treatment. Unless and until the radiologist knows as much about every aspect of breast cancer as does the surgeon—apart, of course, from operative technique—he must not expect the

medical and lay public to recognize him as the principal person to have charge of a case.

Radiologists have at the moment an opportunity to study breast cancer from a new aspect. The deadliness of this disease lies in its metastases. When once these are clinically evident though much may still be done the patient's life is ultimately forfeit. If however, we could get warning of an outbreak at the pre-clinical stage we might perhaps do something useful. It is claimed by certain biochemists that the vanadic acid sedimentation test is capable of giving such a warning by showing the blood picture to be moving in an abnormal direction. How long the warning is ahead of the active mischief we do not yet know nor whether the seeming danger signal is always justified.

Confining oneself to facts which appear well authenticated one can say that most breast cases show an abnormal blood at the time of diagnosis—that with the removal of the primary growth whether by operation or radiation the reaction becomes normal in some cases and remains or again becomes abnormal in others—and that it can in many instances be brought back again to normal by widefield x-ray treatment of low intensity. The effect is constitutional and must be sharply distinguished from intensive methods designed to produce a local reaction. We do not know for certain whether metastases can develop in the face of a blood normal to the vanadic acid test, but the investigation linking up as it does radiology with biochemistry would seem to be worth pursuing.

Training of the Radiotherapist—It is obvious that our colleagues, and more especially those who are in general practice, will not accept us as authorities on certain diseases—even when radiotherapy is admitted to be of prime importance in their treatment—unless by training and qualification we can inspire confidence. At least three years spent in house appointments would seem desirable, and although it may perhaps be a counsel of perfection, a year in general practice would be of the utmost value. At the end of this time, a higher medical qualification should be aimed at.

With regard to the more technical side of radiologic education I am in agreement with Dr. R. S. Paterson who, in his presidential address last year, expressed a doubt as to whether the enthusiasm for physics was not being carried a little too far. It is not that any of us could know too much physics, but when time is limited, as it must be, one has to consider its value in relation to other studies. For instance, there is biochemistry, which I feel will become of increasing importance to the radiotherapist. And there is the general pathology and clinical aspect of diseases amenable to x-ray treatment. Concerning a physical problem we can always consult a physicist, but faced with a patient we must depend on ourselves.

Dr Paterson, in his address referred to the matter of a higher diploma in radiology—which he said would have to be seriously taken up in the future. It is already the future by 12 months, and, in my opinion, it is time that some preliminary steps were taken to realize this ideal. The first of these steps, which must be taken by radiologists themselves, might perhaps be the provision of some form of recognition for those who have done original work of value to radiology.

In conclusion, if anyone says that the road I have outlined is too hard a one for the neophyte to tread, I would remind him of the old proverb which says that, "he who wills the end must also will the means", or, if a classical quotation be preferred, *per ardua ad astra*.

F HERNAMAN-JOHNSON, M D

London, England

Hon Radiologist to the French Hospital,
London, Physician in Charge of Radiotherapeutics, Croydon General Hospital

ANNOUNCEMENTS

AMERICAN BOARD OF RADIOLOGY

The American Board of Radiology has decided to hold a meeting on the West Coast about the middle of May, 1935, at which time candidates will be examined for certificates. The Board has chosen to do this because of the fact that there are a number of applications on file from that section of the country, and it was felt that a meeting should be held at a place where it would be convenient for such applicants to appear before the Board. Anyone who is desirous of appearing before the Board at that time should have his application completed and on file in the Secretary's office not later than March 1, 1935.

There will also be a meeting of the Board in Atlantic City, June 8, 9, and 10, 1935, at the time of the session of the American Medical Association. Anyone wishing to appear before the Board at that time should have his application in the Secretary's office not later than April 1, 1935.

The minimum requirements for eligibility to make application for a certificate are

1 Membership in at least one of the national radiologic societies, the American Medical Association or the Canadian Medical Association

2 At least three years' experience in radiology during which time not less than 75 per cent of the applicant's time has been devoted to radiology

3 That the applicant does not hold or has not applied for a certificate from a specialty board, and that he does not list himself in the American Medical Directory or elsewhere as a specialist in some branch of medicine other than radiology

4 That at least 75 per cent of the applicant's time is being devoted to radiology

B R KIRKLIN, M D

Secretary-Treasurer of the
American Board of Radiology

SURGEONS TO MEET IN JACKSONVILLE, FLORIDA

The Southeastern Surgical Congress, through its secretary, B T Beasley, M D, announces the sixth annual assembly of the Congress which will be held in Jacksonville, Florida, March 11, 12, and 13, 1935. The Congress has met previously in Atlanta, Birmingham, and Nashville.

The States composing the Congress are Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. A record attendance is anticipated at the Jacksonville meeting. Since March is the most desirable month to visit the land of flowers many surgeons will no doubt combine business and pleasure and attend during this season of the year.

Some of the most distinguished surgeons in the country, representing the different surgical specialties, have been invited to appear on the program. A partial list of those who have already accepted places is as follows: Walter C Alvarez, M D, Perry Bromberg, M D, Hugh Cabot, M D, Willis C Campbell, M D, George W Crile, M D, John F Erdmann, M D, Paul Flothow, M D, Ralph Green, M D, Arthur Hertzler, M D, C Jeff Miller, M D, Alton Ochsner, M D, J C Patterson, M D, J Knox Simpson, M D, J W Snyder, M D, and W A Weldon, M D. More than twenty others will be listed when the program is completed. Look for the completed program which will be mailed about Feb 15, 1935.

For information address B T Beasley, M D, Secretary-Treasurer, 1019 Doctors Building, Atlanta, Georgia

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BONE DISEASES (DIAGNOSIS)

Osteodystrophia Fibrosa Unilateralis Karl Goldhamer Fortschr a d Geb d Röntgenstrahlen, 1934, 49, 456-481

This is a detailed case report of osteitis fibrosa cystica (Recklinghausen) in a girl nine years of age, observed for four and a half years and verified histologically. Unusual observations (1) Diffuse fibrocystic disease involving the *left* ischial bone and the *left* upper and lower extremities, lesions are found to diminish in extent from proximal to distal and from lateral to medial in the left hand and foot, (2) circumscribed fibrous changes are found in the *left* cranial vault, diffuse fibrous changes in the *left* mandible and the *left* occipital bone, (3) cystic changes are observed in the *left* pelvis, femur, tibia, and fibula, (4) osteosclerotic changes have been demonstrated in the *left* half of the base of the skull and the *left* facial skull, (5) *pubertas præcox*. There follows a discussion of differential diagnostic possibilities.

H A JARRE, M D

Osteosarcoma in the Course of Paget's Disease of Bones J Haguenau, L Gally, and P Daum Bull et Mém Soc Med des Hôp de Paris, June 4 1934, 50, 786-793 (Reprinted by permission from British Med Jour, Oct 6, 1934, Epitome of Current Medical Literature)

Paget observed the frequent occurrence of sarcoma in the disease bearing his name, and Leri noted that this malady predisposes to gout and cancer, especially osseous cancer several cases are recorded in the literature.

The authors present details of a case of Paget's disease in which an osteosarcoma of the right knee with metastases in the cervical vertebral region developed. Death supervened in six months after the first appearance of pains in the knee. In most cases these tumors appear after the age of 50, and much more frequently in males, and they invariably develop on bones presenting at least radiologically, the characteristics of Paget's disease, and never on normal ones.

Histologically, they most frequently resemble ordinary sarcoma, in one case however, myeloplasic tumors occurred and in another von Albertini noted that the marrow of the affected bones was converted into a tissue of fusiform cells, sarcomatous in appearance, and he suggests the possible formation in "pagetic" bones of a presarcomatous tissue capable of true sarcomatous degeneration. The present authors believe that this complication is too infrequent to permit of this hypothesis, and consider that these cases are analogous to those neoplastic degenerations following chronic irritation. The prognosis of these sarcomas is rapidly fatal and no treatment is of any avail.

A Contribution to Etiology and Roentgen Diagnosis of Bone Sarcoma, with Remarks Concerning "Osteoarthropathie Hypertrophante Pneumique" J Palug

Fortsehr a d Geb d Röntgenstrahlen, August, 1934, 50, 107-120

A case is reported wherein, following trauma symptoms of osteomyelitis of the right femur developed. During the course of several months the bone lesion was recognized as an infected osteochondrosarcoma. Ex-articulation at the hip was followed by well being for over one year, when mediastinal lymphoglandular metastases developed producing a stenosis of the right lower bronchus with consecutive atelectasis of the right lower lobe. Simultaneously, the typical picture of "osteoarthropathie hypertrophante pneumique" developed.

There follows a discussion concerning the relationship of trauma to the development of a bony malignant neoplasm. On the basis of the analysis of clinical roentgenologic, and histologic findings in this case it is assumed that the trauma led to sarcomatous degeneration of an occult, quiescent chondroma, followed by autogenous infection, with osteitis. The differential diagnosis between benign osteitis and a malignant bone tumor is discussed. Finally, the symptomatology of the osteoarthropathy and its etiology are mentioned.

This osteoarthropathy was described first by Pierre-Marie and is known under the names 'osteoarthropathie hypertrophante pneumique', toxic proliferating periostitis, arthropathia hypertrophicans toxica, akropachie, toxigenous ossifying osteoperiostitis. The etiology of this rare symptom-complex is traced to chronic infectious processes, especially putrid pulmonary infections, chronic infectious cardiovascular disease, chronic stimulation of bone by toxins, including chronic passive congestion. Pulmonary tuberculosis, bronchiectasis, lymphogranulomatosis, chronic diseases of the liver and kidneys, chronic lymphadenitis, dysentery and various other types of chronic infectious diseases are reported to elicit the bony manifestations which have to be regarded as chronic inflammatory changes, leading partly to atrophy and rarefaction, partly to hypertrophic osteitis. A generalized osteophytosis has been observed and also multiple toxic arthritis. The terminal phalanges of the hands show clubbing. These bony changes may not produce any subjective complaints in very mild cases, while in more advanced instances there is pain on pressure on the bones and intermittent spontaneous bone pains, occurring particularly at night, of one to several hours' duration. In the most advanced cases hands and feet become tremendously enlarged so as to resemble giant paws, with diffuse swelling of forearms and legs. In such an instance the primary underlying disease may be entirely obscured by the manifestations in the extremities. Symptoms always are quite symmetrical in distribution involving the diaphyses of the long bones particularly radius ulna, tibia fibula, femur, metacarpals, metatarsals, while participation of the humeri has been seen only rarely. Mandible and spine hardly ever are involved.

When recurrences develop one may observe irregular, jump osteophyte formation. Destructive bony

changes are seen in the epiphyses and apophyses chiefly manifest as a queer rarefaction of the *spongiosa*. Whenever the disease is well developed, acromegaly will have to be considered for differential diagnosis. Then it is to be remembered that in the case of the osteoarthropathy the clubbing of the terminal phalanges is present, beside the enlargement of the hands. Furthermore, one should observe enlargement of the bones simulating swelling of the articulations. The skull in all such instances is negative. In acromegaly, on the other hand, one will find a practically normal configuration of hands and feet in spite of the enlargement, the latter terminates at the joints. Arnold, Erb, and von Recklinghausen however assume that mixed types occur. Roentgenologically, syphilis of the skeletal system may be considered for differential diagnosis. Comparative views of symmetrical portions of the skeleton, multiple localization and etiologic primary disease will lead to a differential diagnosis.

H. A. JARRE, M.D.

CANCER (DIAGNOSIS)

The Diagnosis and Treatment of Primary Carcinoma of the Bronchus or Lung. EVARTS A. GRAHAM. *Am Jour Roentgenol and Rad Ther* February 1934 31, 145

It is now known that primary carcinoma of bronchus or lung constitutes at least 5 to 10 per cent of all carcinomas. Practically all if, indeed not all, of them arise in a bronchus the usual location being one of the primary divisions of the main bronchus. The undifferentiated basal cell is thought by some to be the source of the several cellular types of carcinoma arising in this location. While ulceration usually occurs rather early, with broncho-stenosis or bronchial occlusion and atelectasis, one may occasionally encounter a case in which the tumor grows diffusely about the bronchus and is slow to produce ulceration or bronchial obstruction. Symptoms may occur first from metastases particularly if the latter are located in the long bones or brain. The duration of the disease is quite variable the average period between onset of symptoms and death being less than two years.

Of 26 proven cases with necropsy studies 17 complained on admission to the hospital of cough 11 of chest pain or discomfort, 11 of dyspnea, and 10 of expectoration, while at the same stage only six noted weakness and nine weight loss. While bronchoscopy with removal of a bit of tissue is usually necessary to establish an absolute diagnosis the author warns against the danger of making a definite diagnosis of malignancy by an inexperienced pathologist in cases in which there is only metaplasia or hyperplasia as may occur in bronchiectasis. Occasionally lipiodol is useful in showing the tumor to be extrabronchial particularly in the presence of atelectasis.

As concerns therapy the writer doubts the adequacy of bronchoscopic removal and/or deep radiotherapy. He briefly reports one case of a physician with a primary carcinoma of the squamous-cell type arising from the left main stem bronchus from whom he successfully

removed the entire left lung at one stage. Six months after operation the patient had gained 16 pounds in weight, was gaining in strength, and was aware of no more dyspnea on exertion than a normal man of his age.

J. E. HABBE, M.D.

CANCER (THERAPY)

The Influence of Ultra short Electrical Waves on Malignant Tumors. E. HASCHÉ and W. A. COLLIER. *Strahlentherapie*, 1934, 51, 309.

The authors studied the effect of electric waves of 3.5 meters length on transplanted carcinoma (Ehrlich strain) in mice. They found that neither total body local treatment, nor exposure *in vitro* had any effect on the malignant neoplasm.

ERNST A. POHLE, M.D., Ph.D.

A Preliminary Report Concerning our Three Years Experience in Cancer Therapy with Extremely Hard Roentgen Rays. E. v. SCHUBERT. *Strahlentherapie* 1934 51, 271.

The author relates his experience with super high voltage in the treatment of advanced gynecologic carcinomas during the last three years. He used about 600 K.V., 1-2 ma., 94 cm. F.S.D., 3 mm. Cu + 3 mm. Al, the output was 2-4 r per minute. If 20 single doses of 200 r were applied on successive days no untoward skin reactions were observed. Later he applied as much as 4×500 r in 2 days, this could be increased to 4×750 r. Four to six weeks after roentgen therapy radium may be applied in doses of about 3,000 to 4,000 milligram hours. Since only far advanced cases were used no definite evaluation of the treatment for early carcinoma can be given. The results were, however, encouraging enough to warrant further effort and expense toward the development of super high voltage therapy.

ERNST A. POHLE, M.D., Ph.D.

Stubborn Skin Cancer and its Cure. A. HINTZE. *Strahlentherapie* 1934 51, 237.

The author presents a critical analysis of 71 cases of skin carcinoma which did not remain cured following treatment by either operation or irradiation. His statistics show that 39 cases were operated on and 32 treated by x-rays or radium. Sixty-two cases had cancer of the face (16 multiple lesions). In four patients the lesions were on the body or on the extremities. Three cases had a lupus carcinoma and one a roentgen carcinoma. Four patients primarily operated on and operated on repeatedly after that were not cured. Thirty-five patients were primarily operated on and then irradiated, 19 of these were cured by roentgen therapy. Seventeen patients had been irradiated in some other clinic first and developed a recurrence being mostly re-treated by irradiation four of these were cured. Fifteen cases treated primarily in the author's clinic developed multiple lesions in nine cases while in six patients there was a recurrence of non healing of the original lesion. Eight out of the group with

multiple lesions and three out of the group with recurring lesions are cured now by irradiation. Of the three cases with recurrences which did not heal following repeated irradiation two were treated with multiple small doses and one with medium large doses. None of these patients had been treated with massive doses when first seen. The author comes to the conclusion therefore, that except for patients with multiple lesions, the non healing of the skin carcinoma is in all probability due to insufficient treatment when the patient is seen for the first time.

ERNST A. POHLE, M D, Ph D

Roentgen Therapy through Small Fields in Deep-seated Tumors. A. Kułowska. *Strahlentherapie*, 1934, 51, 312

In order to obtain a high depth dose with as little injury to the skin as possible the author has developed a "small field technic". He uses as many as ten or more 4 sq. cm. areas. Each field receives 600 r (0.5 Cu 180-200 K.V. 3-4 ma., 23-50 cm. F.H.A.). Using 10 fields with this technic, the tumor receives approximately 3,000 r, one field being exposed each day. Although it is too early for a statistical evaluation of this method the author has seen encouraging results and also believes that it is possible to bring as much as from 4,000 to 8,000 r into the tumor.

ERNST A. POHLE, M D, Ph D

The Incidence of Vaginal Fistulae in Patients with Carcinoma of the Cervix. Frank R. Smith. *Am. Jour. Cancer*, September, 1934, 22, 52-58.

This paper is an attempt to answer the question of the frequency of vaginal fistulae following irradiation therapy for carcinoma of the cervix. A comparison made with a group of untreated patients showed that vaginal fistula incidence is primarily a manifestation of advancement of the disease, the incidence being twice as high in the untreated patients. In irradiated patients the incidence is increased by interstitial radon irradiation, lack of filtration, re-treatments, infection, structural type of lesion, and hysterectomy before irradiation.

W. A. SODEMAN, M D

Chemotherapy as a Supplementary Treatment in Radiation Therapy of Malignant Disease. F. Nahm-macher. *Strahlentherapie*, 1934, 51, 305.

The author believes that chemotherapy can be used as a valuable adjunct to radiation therapy of carcinoma. He recommends a preparation containing a combination of lithium, magnesium, and iodine compounded in such a manner as to avoid irritation of the intestinal tract. A hypothetical explanation of the effect of each element in the medication on the cancer patient is offered. The author also emphasizes that his preparation is non-toxic and does not produce any of the symptoms of iodism.

ERNST A. POHLE, M D, Ph D

CATHODE RAY

Possibilities of High Speed Cathode Rays in Therapy. A. Brasch and F. Lange. *Strahlentherapie*, 1934, 51, 119.

The authors constructed a cathode tube which can be operated at 2,000,000 volts. They consider as an advantage of cathode rays the well defined length of path, the fact that more energy is released in the depth than on the surface, their enormous biologic effect, and the possibility of "aiming" the beam by means of magnets. The length of path in tissue for cathode rays produced at 2,000,000 volts is about one centimeter. The maximum effect seems to be at about 2 mm. depth, a fact which has been proved experimentally by placing over the skin a filter of a thickness equivalent to the length of path. One thousand erythema doses were applied without causing any effect on the skin. Photographs are shown with the article demonstrating the destructive effect of cathode rays on metal and insulating material. The technic of application is described; it is possible to use a small "injection" needle with a window, which can be introduced into a deep seated malignancy. This permits irradiation at the site of the lesion without exposing the tissue between the skin and the tumor.

ERNST A. POHLE, M D, Ph D

Radiobiological Experiments Undertaken as a Basis for the Use of High Speed Cathode Rays in Therapy. R. Glocker, G. A. Kugler, and H. Langendorff. *Strahlentherapie*, 1934, 51, 129.

The authors experimented with the tube built by Brasch and Lange (see *Strahlentherapie*, 1934, 51, 119) on *Drosophila* eggs. They determined the distribution of the cathode ray energy (1.6 million volts) in the depth of a phantom. They found that at a certain depth the dose was about one and a half times as large as the surface dose. This is considered as one of the greatest advantages of cathode ray therapy.

ERNST A. POHLE, M D, Ph D

Studies of the Biologic Effect of Cathode Rays. W. Gentner and F. Schmidt-La Baume. *Strahlentherapie*, 1934, 51, 139.

The skin of rabbits was exposed to a Lenard tube (212 K.V., 1 ma.) at 9.45 cm. distance. At the same time, exposures were given with Grenz rays in order to compare the effect on the skin. The cathode ray intensity was varied by means of a concentration coil (see *"Strahlentherapie"*, 1931, 42, 1). Clinical and histological studies of the skin reactions showed that they went parallel to the dose applied. The Grenz rays used were produced with a potential of 13.5 K.V. The reaction took an entirely different course as compared with that observed after exposure to cathode rays. This observation is explained by the difference in the absorption of the two types of rays.

ERNST A. POHLE, M D, Ph D

DOSAGE

Relation between X ray Dosis and Rate of Mutation K G Zimmer *Strahlentherapie*, 1934, 51, 179

The author compared the experimental results published by a number of authors who have studied the rate of mutation in *Drosophila melanogaster* after irradiation. He found that there is an exact linear relation between dose and rate of mutation.

ERNST A. POHLE, M D, Ph D

HEART AND VASCULAR SYSTEM

Changes of the Cardiac Contour and Size, Produced by Increased Intra pulmonary Pressure, Investigated Kymographically (Cardio-kymograms during the Valsalva Experiments) F A Nolte *Fortschr a d Geb d Röntgenstrahlen*, September, 1934, 50, 211-230

Increase of intra pulmonary pressure of 10 mm Hg regularly produces a reduction of the size of the heart of healthy individuals. Only in rare instances is an increase of 35 mm Hg necessary to produce this effect. This symptom was demonstrated in kymograms obtained in the postero anterior as well as in the first and second oblique projections.

The reduction involves all cardiac segments simultaneously, an isolated enlargement of any cardiac segment as a result of increased intra pulmonary pressure could not be demonstrated. The reduction is most marked in the region of the cardiac apex. Cardiac reduction was usually noted immediately during the first systole following the increase of intra-pulmonary pressure. One third of the cases investigated show a temporary initial enlargement of the heart during the increased pulmonary pressure which is interpreted as a sudden evacuation of deposits of blood in liver and lungs resulting from compression of these organs. The maximum reduction of the size of the heart usually is obtained within from three to five seconds following introduction of a pressure of 40 to 70 mm of mercury. After this initial reduction no further changes could be induced.

Quiescence of the heart never was observed under prolonged pressure, even up to 20 seconds, distinct pulsations of the cardiac margin were observed always, regardless of the duration of the pressure. This is contrary to opinions formed from fluoroscopic observations and graphic registration of pulse curves.

The most rapid reduction in the size of the heart was observed with introduction of very marked pressure differences—20 to 90 mm of mercury. This was the only relationship noted between the height of the pressure and the type of diminution of the size of the heart. Immediately upon restoration of normal intra pulmonary pressure blood returns from congested veins to the heart and thus leads to temporary enlargement of it. This enlargement involves all cardiac segments simultaneously. From these experiments it is concluded that apparent changes in cardiac size produced by the Valsalva experiment are to be interpreted as

the effects of impaired influx of blood to the right and left cardiac segments.

H A. JARRE, M D

HODGKIN'S DISEASE

Five year Survival in Hodgkin's Disease Lloyd F Craver *Am Jour Med Sci*, November 1934 188, 609-612

Craver reports the results of irradiation in 310 cases of Hodgkin's disease, 125 of which were proved by biopsy. Of the whole number, 103 per cent, which includes 16.8 per cent of those biopsied, survived five years. Analysis of the age incidence disclosed that the five year survivors averaged ten years younger than those surviving less than six months. Histologic studies did not account for these differences, which are ascribed to variations in the virulence of the disease.

Favorable prognostic evidence includes localization of the disease, especially in the upper cervical region with early surgical and radiologic therapy, a normal leukocyte count, and a gain in weight following irradiation. Fever, marked pruritus, and splenomegaly were unfavorable.

W A. SODEMAN, M D

Irradiation in Lymphosarcoma, Hodgkin's Disease, and Leukemia. Statistical Analysis T Leucutia *Am Jour Med Sci*, November, 1934 188, 612-623

This report is a statistical analysis of 2,425 cases collected from the literature, as well as 129 cases of the author's own. In all three conditions lymphosarcoma, Hodgkin's disease, and leukemia irradiation is the treatment of choice. In lymphosarcoma results are termed 'spectacular' with 30 per cent five-year cures and from 10 to 15 per cent ten-year cures. In Hodgkin's disease 15 to 33 per cent of the patients survive five years. In those dying before five years, life expectancy was increased from two to three and one-half years. Symptomatic relief results as well. In leukemia the important result of treatment is also symptomatic. The life expectancy is not prolonged but the patient is made more efficient during the course of the disease. Acute forms are not affected.

W A. SODEMAN, M D

RADIATION EFFECTS

Experimental Studies Concerning the Effect of Roentgen Rays on Yeast Fermentation V Gronchi *Strahlentherapie* 1934, 51 319

The effect of roentgen rays on the fermentation of *Saccharomyces cerevisiae* in the presence of glucose was studied. If roentgen rays of a wave length of 0.37 Å and 0.16 Å in doses of from 600 to 1,800 r were used there resulted a definite functional stimulative effect manifested by an acceleration of the CO₂ production. It appeared that the stimulative effect is proportional to the intensity of the irradiation—it seemed somewhat larger with hard rays than with soft rays.

ERNST A. POHLE, M D, Ph D

RADIUM

Radium Therapy of Cancer of the Palatine Tonsil and the Pillars Angelo Santoro d'Emidio Arch di radiol., 1934, 10, 208-224.

The author points out the great advantages of interstitial radiation in treatment of cancers in the region of the tonsillar ring and describes in detail his own technic of treatment of these lesions. By it he obtained excellent results and he feels that by it the great danger of hemorrhage is minimized. He does not think that external radiation alone will clear up the majority of these lesions, but may cause them to regress for a considerable length of time. A combination of external radiation by means of moulded applicators with buried tubes of radium leads to the best results, not only with regard to the primary lesion but also to its lymphatic metastases.

E. T. LEDDY, M. D.

A Cytologic Study of the Living Body Irradiated with a Hard Ray. Part I, Influence of a Hard Ray upon the Development of Beans and the Abnormality of the Nuclei and Cell Division. T. Saito Japanese Jour. Obst. and Gynec., August, 1934, 17, 285-290, 20 plates.

Saito has studied the influence of radium upon the development of bean roots to note the effect of irradiation upon cells free from the influence of blood supply, congestion, endocrine factors, immune processes etc., as would prevail in the human body. Results show inhibition of cell development, with abnormalities in cell and nuclear division. First the cytoplasm swells, followed by coagulation and loss of function, changes interpreted as first physico-chemical, then disturbed metabolism, and later extinction of cells.

W. A. SODEMAN, M. D.

The Problem of Radium Dosimetry. W. Friedrich Strahlentherapie, 1934, 51, 7.

During the last years numerous investigators have made an attempt to determine radium doses in r, there is, however, a discrepancy in the results obtained. The author and his co-workers have studied this problem in great detail, therefore, and describe two types of apparatus which are suitable for standardization of radium doses in r. One can be brought as close as 2 cm to the radioactive substance, while the second type, using an amplifier and a very small ionization chamber, is suitable for measuring isodose curves in close proximity to the radium applicator. The construction of the small chamber is described, the measurements show that the filtration of the radio-active substance influences greatly the number of r delivered per mg-hr at 1 cm distance. The secondary radiation emitted by the filter was also studied, it further appeared that even distribution of the radium salt within an applicator is of great importance.

Additional measurements were made in order to compare the results obtained by ionization instruments with those obtained by Holthusen and his co-workers

with the photographic method. While a satisfactory agreement exists in certain points, there is definite discrepancy in, for instance the doses in the depth. It appears that for a filter of 0.3 mm Pt, the dose is 11.2 r in 1 cm distance for 1 mg radium.

ERNST A. POHLE, M. D., Ph. D.

Use of Radium in Carcinoma of the Bladder. A. J. D. Smith. British Med. Jour., Sept. 29, 1934, 2, 584.

Smith points out the wide divergence of opinion as to the use of surgery and radiation in the treatment of carcinoma of the bladder, and believes that the surgical inaccessibility of the majority of cases when first seen suggests a field for radium, as in cancer of the cervix. He prefers the use of radon seeds, applied suprapubically or cystoscopically, as the case demands.

Results are comparable to Barringer's in this country. They show that papillary carcinoma is sensitive to radium and amenable to such treatment when not too extensive and when the growth is confined to the bladder. The infiltrating type is more radioresistant and operative cases of this type should, he believes, be treated by resection. Great care must be taken in the selection of inoperable cases suitable for radium treatment. The extravascular spread of these cases may require widespread interstitial irradiation, which may make the patient more miserable than he was before.

Experience with 60 cases shows that cystoscopic implantation of seeds should be limited to those cases of papillary carcinoma in which the growths are not more than 2 to 3 cm in diameter. Larger growths should be treated suprapubically.

W. A. SODEMAN, M. D.

Complications Following Radium Therapy of Tumors of the Bladder and Neighboring Organs. W. I. Korchow. Strahlentherapie, 1934, 51, 164.

The author noticed a series of complications in patients with carcinoma of the prostate and uterine cervix particularly after *sectio alta*. He found that the cystitis which existed before operation or irradiation was a principal cause for the necrosis developing later. A few photomicrograms are shown with the article demonstrating the marked changes found in the bladder wall. Before subjecting this type of patient to irradiation, the author urges that a careful study of the rectum as well as the entire uropoietic system be undertaken.

ERNST A. POHLE, M. D., Ph. D.

The Field of Application for Radium. R. Stewart-Harrison. Strahlentherapie, 1934, 51, 57.

At the Roentgen Institute of the University of Zurich, 98 radium applications were made during 1929-33. In 14 cases radium alone was used as the primary method of treatment. In eight cases it was applied after initial treatment in another clinic. Seventy-six patients received combined treatment with x-rays and radium, 49 of the latter group had carcinoma of the esophagus. The radium applicators including the technic used, are

described in detail. A number of case reports are appended, with data on dose, technic and end results.

A critical analysis of the entire clinical material leads the author to the conclusion that carcinomas of the skin, lip, tongue, and uterus are most suitable for radium therapy. It may also be used, particularly in the interstitial form, for the removal of residual tumors treated first by x rays. The painful and slow healing ulcers occurring sometimes after implantation of radium needles may be benefited by short wave diathermy.

ERNST A. POHLER, M.D., Ph.D.

SELLA TURCICA

The Detailed Anatomy of the Sella Turcica and its Clinical Significance for the Recognition of the Size of the Hypophysis, A Contribution to the Study of the Relationship of the Size of the Hypophysis and the Size and Form of the Sella Turcica to Anatomic and Functional Hypogonitalism. O. Bokelmann. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1934, 49, 364-396.

There is no direct relationship between the size (capacity) of the pituitary fossa and the size (weight and volume) of the related pituitary body. A decidedly small pituitary body may often be situated in a small pituitary fossa but a large pituitary body not uncommonly occurs in a medium or small pituitary fossa. This statement, therefore, implies that various determinations of the size of the pituitary fossa under physiologic conditions permit of but very approximate inaccurate conclusions as to the size of this appendage of the brain.

This study has shown certain direct relationships between the size (weight and volume) of the pituitary body and the size of the anteroposterior median profile of the pituitary fossa which under physiologic conditions permit of the following useful clinical conclusions:

(a) A small pituitary fossa in females always contains a small pituitary body, but in males it may contain either a small or a medium sized pituitary body.

(b) A definitely small median pituitary fossa profile corresponds in 60 per cent of all cases to a small pituitary body, sometimes it may correspond to a medium but never to a large pituitary body.

(c) A definitely large median pituitary fossa profile usually corresponds to a large pituitary body occasionally however, to a medium sized never to a small pituitary body.

(d) Medium sized pituitary fossa profiles are observed in various types of pituitary body sizes.

Determinations of the actual size of the pituitary body from the size of the pituitary fossa profile become increasingly incorrect with advancing age especially above approximately 56 years.

The size of the lateral sella turcica profile cannot be used at all for a determination of the size of the hypophysis. All conclusions reported above are drawn from the profile of the sella in the correct median plane.

An estimation of the size of the hypophysis as judged by the size of the median profile of the sella is permis-

sible only if median and lateral profiles of the sella either can be differentiated clearly or may be recognized as with certainty coinciding. An exception may only be granted in cases of so-called bridge formation between the clinoid processes, in such instances the hypophyses usually are small, even in case the median profile of the sella is fairly large.

Formation of bridges between the clinoid processes is seen unusually often in individuals who suffer from some kind of dysfunction of the genital system or have hypogonitalism. (Of all adults with such functional disorder, 50 per cent show such bridging.)

The average weight and volume of hypophyses show increasing fluctuation with increasing age.

The average weight of the hypophysis is higher in females than in males regardless of age.

About 50 per cent of all females and from 50 to 60 per cent of all males with small hypophyseal weight—below average—show symptoms of developmental or functional hypogonitalism.

H. A. JARRE, M.D.

SKIN (GENERAL)

Spectrophotometric Studies on Human Skin with Special Consideration of the Determination of the Degree of Erythema and Pigmentation. H. G. Bode. *Strahlentherapie*, 1934, 51, 81.

The author reports in detail his studies concerning the exact measurements of erythema and pigmentation of the human skin following irradiation. The spectrophotometric method is the most accurate way to obtain reproducible results. A series of curves show the behavior of normal human skin as compared with skin showing erythema or pigmentation.

ERNST A. POHLER, M.D., Ph.D.

Sieve Radiation. W. Haring. *Strahlentherapie* 1934, 51, 154.

The author studied the skin reaction following x-ray exposure through a lead plate 3 mm thick with holes of 3 mm diameter. It appeared that he could give three times the dose as compared with the skin tolerance without the lead plate. He investigated the distribution of the radiation in a water phantom by placing films in a horizontal position at 2, 4, 6, 8 and 10 cm depth. The films showed that the rays continue as 'needles' throughout the water and do not unite in other words they show the pattern of the sieve.

ERNST A. POHLER, M.D., Ph.D.

Melanotic Neoplasms of the Skin. S. William Becker. *Am. Jour. Cancer*, September 1934, 22, 17-40.

Becker points out that the advent of new methods of study especially the silver method which causes a darkening of pre-existing melanin and the 'dopa' reaction which demonstrates pigment-forming cells has revolutionized the study of pigmentation. He has found the dendritic type of cell described by Maximow at or near the epidermo-dermal junction in all pig-

mented epithelium, and cites the belief of Masson that these specialized cells, which transfer preformed pigment to the palisade basal cells, are the only pigment-producing cells. These pigment forming cells are called melanoblasts" and an increase in their number results in a smooth brown nevus. The cells forming elevated nevi are thought to be derived from the same source. When located deeply in the dermis a blue nevus or Mongolian spot results. The source of melanoblasts, although not known is thought to be nervous.

Irradiation by ultra violet or alpha rays causes a prominence and branching of melanoblasts followed by hyperpigmentation of palisade basal cells. "Lentigo" is a lesion resulting in the same histologic picture from no demonstrable cause. With pigment activity progressing to a point at which melanoblastic proliferation occurs the lesion is called "lentigo maligna". Further activity produces melanoma which arises from the melanoblastic cells at the epidermo-dermal junction and not in deep-lying nevus cells. Many cutaneous carcinomas contain melanin due to the presence of normal appearing melanoblasts.

W A SODEMAN M D

THE SPINE

The Clinical Importance of the Intervertebral Discs, with Special Reference to Nuclear Prolapses. Gilbert B Bush. *Bristol Medico-chi Jour* 1934 51, 173-182.

Bush draws our attention to a study of the intervertebral discs as a site of important spinal disease. The anatomy of the normal disc is discussed, with a description of the fibro-cartilaginous annular portion containing the nucleus pulposus in its center. The nucleus pulposus containing fluid under pressure, is placed between the epiphyseal end plates of the vertebral bodies to act as a shock absorber and a sort of roller-bearing on which spinal movements occur. If disease involves the cartilaginous end plate seepage of fluid from the nucleus pulposus takes place and elasticity of the disc is lost. Erosion by pressure may occur in the vertebral body, even to the extent that prolapse of the nucleus through a fissure to the bony spongiosa may take place.

These changes occurring often in young adults may be manifested clinically by pain in the back and a slight degree of kyphosis. Radiographs may show irregular contour of the upper and lower margins of the vertebral bodies especially in the lower dorsal region. Wedging of the vertebral bodies and narrowing of the intervertebral spaces may occur. Therapy consists of rest and fixation.

W A SODEMAN M D

TUBERCULOSIS PULMONARY

Tuberculous Lesions in Children of School Age. H W Hatherington. *Penn Med Jour*, September, 1934, 37, 990-992.

The most serious problem to be considered in the study of tuberculous lesions in white children of school age is the diagnosis and treatment of apical tubercu-

losis in adolescent children. The tuberculous lesions observed between infancy and puberty in whites are usually benign, however, negro children are more susceptible to tuberculosis and are not uncommonly afflicted by the severer forms of tuberculosis which are usually confined to infancy in the white race.

The adult or apical form of tuberculosis found in adolescent children spreads downward from the apical region, causing fibrosis and cavitation. The lymph nodes at the root of the lung are not usually involved in this condition. A fairly long latent period is the rule before the onset of clinical symptoms, and while many of these lesions in the latent stage do not progress into clinical tuberculosis the importance of diagnosis during this latent period is obvious. During the years from 1927 to 1931, roentgen-ray studies in the high schools of Philadelphia revealed that apical infiltration was present in 2 per cent of adolescent girls and in 1 per cent of adolescent boys.

The usual forms of tuberculous lesions found in the lungs and lymph nodes of white children between the ages of 5 and 12 years are usually benign and their presence, extent and character can be determined only by roentgen ray study. The most common type of tuberculous involvement seen in this age group is the caseous or calcified nodule, associated with its lymph node lesion. Another form of tuberculosis seen at this time of life is the diffuse childhood-type infiltration. Roentgen ray examination shows spots, spots and strands, or strands either alone or with calcified areas. This form is also accompanied by lymph node disease. The usual end result in white children is a strand like infiltration with no more significance than a calcified pulmonary nodule. Those cases which progress into clinical disease must be distinguished from non tuberculous pulmonary lesions.

J N ANÉ M D

Notes on the Interpretation of Chest Radiographs, with Particular Reference to Tuberculosis. T Garratt Hardman. *Irish Jour Med Sci* July, 1934, p 305.

The author begins by stating "I am inclined to think that an examination of a series of normal cases teaches one almost as much about pulmonary disease as an examination of pathological cases. He discusses some of the normal radiographic chest findings of normal individuals. The radiographic signs which were looked for as evidence of a tuberculous infection were as follows:

- (1) Calcareous glands in the hila, (2) Infiltration of the pulmonary parenchyma by multiple, typical nodular foci or a localized Assman's or Ghon's focus, (3) Infiltration by fibrous tissue as evidence of a healing tuberculous process. (4) Isolated calcified nodes in the lung tissues indicating healed foci.

G E BURN, JR, M D

Tuberculous and Non tuberculous Pulmonary Infections in Infancy and Childhood. F Maurice McPhedran. *Penn Med Jour* September, 1934 37, 985-989.

The mortality rate of tuberculosis in infancy is greatest in the second half of the first year of life, and in the consideration of the control of this disease the prevention of exposure and the early detection of infection are of the greatest importance. Any attendant with suggestive symptoms should have a complete examination, including roentgenograms. The early diagnosis of the disease in infancy is dependent upon the tuberculin reaction, the roentgenogram, and accurate clinical observation.

The tuberculin reaction is of great value in infancy, for not only does it indicate the existence of infection but sometimes serves as an index of the severity of the infection. A positive tuberculin reaction should be followed by roentgen examination to discover if the lesion is large enough to be seen. If the first roentgen examination is negative, it should be repeated at first monthly, and then quarterly, depending upon the condition of the infant. "As long as no lesion can be discovered by this means either in the lungs or lymph nodes the probability of a serious or progressive infection is small." In the author's experience, "evidence is lacking that tuberculous infection of which the sole evidence is a positive tuberculin reaction is sufficient to cause fever or ill health in an infant."

The roentgen lesions of tuberculosis of infancy may be considered as those of the lungs and those of the lymph nodes, but it must be remembered that the latter condition results from the primary infection of the lung. A pulmonary lesion may spread by contiguity or by the bronchi, or, by overwhelming the damaged lymphatic nodes, result in fatal miliary disease or meningitis. Tuberculous bronchopneumonia, appearing as a grouped mottling, is another type of tuberculous infiltration observed in infancy.

In the treatment of the enlarged uncalcified pulmonary lymph node, attention should be directed particularly to the prevention of further burden on the damaged nodes, not only as a result of reinfection but also by other non tuberculous pulmonary infections. In the treatment of unilateral pulmonary tuberculosis

artificial pneumothorax is considered of great value.

The non tuberculous pulmonary disease of infancy and childhood may be divided into lobar pneumonia, acute bronchopneumonia, and chronic or relapsing bronchopneumonia with or without bronchiectasis. The differentiation of these non tuberculous pulmonary lesions from tuberculosis depends upon the onset, course, and anatomic distribution.

J N ANÉ, M D

ULTRA-VIOLET LIGHT

The Influence of Sunlight on the Red Blood Corpuscles of Man *in Vivo* W W Lepeschkin Strahlentherapie, 1934 51, 339

Red blood corpuscles *in vivo* respond to exposure to visible or ultra violet light in a manner similar to blood corpuscles suspended in a physiological sodium chloride solution *in vitro*. Provided there is a sufficiently long exposure *in vivo*, there is always a lowering of the resistance of the blood corpuscles. The ultra violet rays of the sun do not penetrate in sufficient quantity in the living organism to affect the red blood corpuscles in the same manner—on the contrary, there results an increase in the resistance. It almost seems as if the ultra-violet rays of the sun were protecting the red blood corpuscles against the injurious effect of the visible rays. This holds true, however, only for non pigmented skin.

ERNST A POHLE, M D, Ph D

The Usefulness of the Decomposition of H_2O_2 as a Measuring Reaction in Ultra violet Light Dosimetry H Sostmann Strahlentherapie, 1934, 51, 359

Koepe has developed a measuring method for ultra violet rays using the decomposition of H_2O_2 . The author compares the results obtained by that method with those given by the iodine test of Bering Meyer-Keller. He comes to the conclusion that the iodine test is far more reliable than the H_2O_2 test.

ERNST A POHLE, M D, Ph D

RADIOLOGY

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A STUDY OF THE ESOPHAGUS IN RELATION TO THE HEART, AORTA, AND THORACIC CAGE¹

By SAMUEL BROWN, M D , and JUSTIN E MCCARTHY, M D , Cincinnati, Ohio

SINCE 1910, roentgenologists have manifested greater interest in the study of the position of the esophagus in the presence of cardio-vascular diseases Kovacs and Stoerk (1) are appar-

in the presence of cardiac enlargement After a long interval of silence, there appeared, in 1924, an excellent study of this subject by Gabert (2), who made a detailed analysis of the changes that take

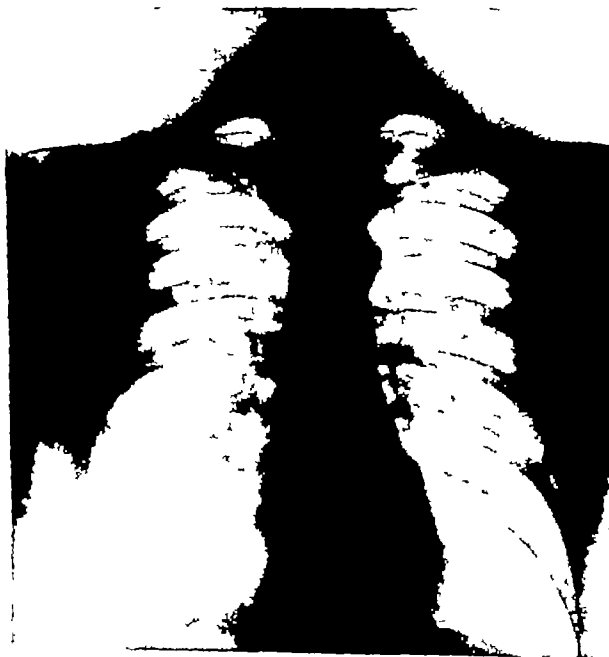


Fig 1-A The esophagus lies in front of the spine through its entire course The left border of the esophagus is slightly compressed at the point at which it crosses the arch of the aorta (Anterior view)



Fig 1-B The esophagus lies midway between the anterior and posterior thoracic walls, in the superior mediastinum it lies between the trachea and spine in the posterior mediastinum between the heart and descending aorta (Lateral view)

ently the first to introduce the subject, with a study of the position of the esophagus

¹ Read before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis Tenn Dec 3-7, 1934

place in the position of the esophagus as a result of dilatation of the left auricle The following year Rosler and Weiss (3) contributed a paper on the position of the esophagus in the presence of enlargement



Fig 2 A The esophagus and heart are displaced to the left. The dorsal spine presents a lateral curvature with its convex border pointing toward the right (Anterior view)



Fig 2 B The heart and esophagus are displaced backward as a result of the funnel shaped chest (Lateral view)



Fig 3 A The esophagus is in normal position. atheroma of the arch of the aorta dilatation of the pulmonary artery pulmonary emphysema (Anterior view)



Fig 3 B The esophagus is in normal position. the sternum is bulging forward the spine is kyphotic the distance between the esophagus and the descending aorta is increased (Lateral view)



Fig 4-A The heart presents a mitral configuration. The esophagus is slightly displaced to the right (not seen in the print) (Anterior view)



Fig 4-B The segment of the esophagus which is overlapping the left auricle is displaced backward as a result of dilatation of the auricle (Lateral view)

of the left auricle. In this country, Rigler published two papers, one (4), in 1929, in which he reported the results of his study of the visualized esophagus in the diagnosis of diseases of the heart and aorta, the other (5), in 1933, dealt with the roentgenologic differentiation of lesions of the right and left heart and their relation to the position of the esophagus. In 1930, Paterson (6) contributed a paper in which he discusses the position of the esophagus and bronchi in the presence of left auricular enlargement.

A review of the above papers reveals a very important omission, namely, the failure to describe the normal position of the heart and aorta and their relation to the esophagus, spine, and thoracic walls in the lateral aspect of the chest. It is quite apparent that, without an accurate knowledge of the exact position and relation of the above structures, no correct interpretation can be made from a change in the position of the esophagus. We also note that the chief interest of the authors consists in the study of the position of the esophagus in the presence of dilatation of the left auricle. In our studies during a

period of several years we came across a number of abnormal conditions which may affect the position of the esophagus. It was found that a change in the position of the esophagus does not take place in haphazard manner, but usually follows a certain direction, depending upon the underlying cause. The following abnormal conditions were found to affect the position of the esophagus to a more or less degree:

- (1) Thoracic deformities,
- (2) Pleuro-pulmonary affections,
- (3) Mitral valve lesions,
- (4) Aortic valve lesions,
- (5) General enlargement of the heart with or without aortic dilatation,
- (6) Congenital heart disease,
- (7) Dilatation of the aorta with or without aneurysms,
- (8) Pericarditis with or without effusions.

The roentgenologic study of the position and relations of the esophagus has received our attention in previous publications (7, 8, and 9). For purposes of completeness, a brief review will be presented.

The esophagus bears a constant relation

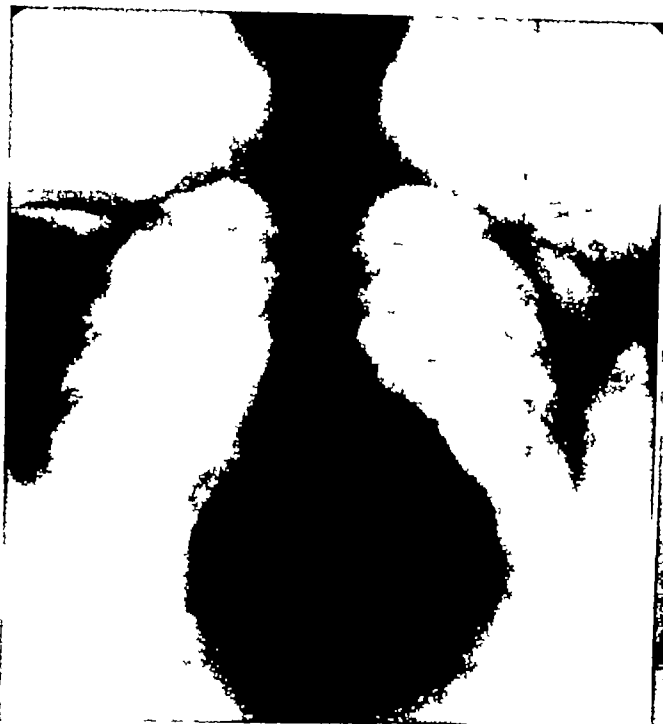


Fig 5-A Great enlargement of the heart, the esophagus is displaced to the right, the right border of the heart is probably produced by the dilated left auricle (Anterior view)



Fig 5-B The esophagus is displaced backward through its entire course as a result of a general enlargement of all the chambers of the heart (Lateral view)

to its neighboring structures thus, a change in the size, shape, and position of the heart and great blood vessels will produce a change in the size, shape, and position of the esophagus. In the antero-posterior position of the chest (Fig 1-A) the esophagus is located in front of the dorsal spine through its entire course, with the exception of the lower portion which deviates to the left before it enters the cardiac end of the stomach. The following structures are crossed by the esophagus from above downward: the arch of the aorta, the right pulmonary artery, and the right bronchus. In the region of the arch, the left border of the esophagus is slightly compressed. In the lateral position of the chest (Fig 1-B) the esophagus, which is attached to the pericardium by connective tissue, lies behind the trachea in the superior mediastinum and behind the heart in the posterior mediastinum. Between the esophagus and dorsal spine

lies the descending aorta. The course of the esophagus is almost parallel to the spine below the arch of the aorta. The average distance between the spine and esophagus is about one inch. In its relation to the anterior and posterior thoracic wall the esophagus occupies a midway position, thus dividing the thorax into two equal parts. Since the heart is located in the anterior half of the thorax under normal conditions, any encroachment of the heart upon the posterior half of the thorax is indicated by backward displacement of the esophagus. Thus the esophagus serves as an important landmark in recognizing enlargement of the heart in the antero-posterior diameter. There are, however, exceptions which will be discussed in the following paragraph.

In the presence of thoracic deformities the mediastinal structures may be found displaced in various ways. The thoracic deformity which is responsible for the



Fig 6 A The heart is greatly enlarged toward the left side, its configuration being that of aortic valve disease. The aorta is moderately dilated. The esophagus is displaced to the left below the arch (Anterior view)



Fig 6 B The esophagus is displaced backward through its entire course, the ascending aorta is dilated and is encroaching upon the anterior clear space, the descending aorta is overlapping the spine (Lateral view)

greatest displacement of the heart and esophagus is that of a funnel-shaped chest. In one case under our observation the heart and esophagus were found displaced to the right and backward, in another, to the left and backward (Figs 2-A and 2-B). Scoliosis may affect the position of the heart and esophagus to a more or less degree, while kyphosis has very little influence upon their position, but the distance between the posterior border of the heart and spine is increased.

The position of the esophagus in pleuro-pulmonary affections is normal as long as the heart and aorta remain in normal position. Any condition of the lungs or pleurae which affects the position of the mediastinal structures will invariably also affect the position of the esophagus. The displacement of the esophagus will be found to be in the same direction as the heart and aorta. Tumors of the posterior

mediastinum, if not too large, will produce a local displacement of the esophagus without affecting the position of the heart. When a mediastinal tumor is of considerable size both the esophagus and heart will be found displaced. In the presence of pulmonary emphysema (Figs 3-A and 3-B) no change is noted in the position of the esophagus, but the distance between the esophagus and dorsal spine is considerably widened.

The displacement of the esophagus in the presence of mitral valve disease takes place in two directions, to the right and backward. The displacement of the esophagus to the right is explained to be the result of rotation of the heart in a counter-clock-wise direction, in the presence of an enlargement of the right ventricle. The backward displacement of the esophagus is simply due to an enlargement of the left auricle or ventricle or both. The degree



Fig 7 A The heart shows left ventricular enlargement. The entire thoracic aorta is dilated and elongated, the esophagus is displaced to the left below the arch (not seen in the print) (Anterior view)



Fig 7 B The descending aorta in its upper two thirds is displaced backward overlapping the spine. The walls of the descending aorta are parallel. The esophagus is displaced backward and follows the curve of the aorta (Lateral view)

of displacement of the esophagus to the right determines to what extent the left auricle is responsible in forming the right border of the heart in the anteroposterior roentgenogram. The backward displacement of the esophagus determines the extent of the enlargement of the left side of the heart. If the enlargement is confined to the left auricle alone, the displacement of the esophagus will be limited to the segment of the esophagus which is in direct contact with it (Figs 4-A and 4-B). When the left ventricle is also enlarged, the esophagus is displaced backward through its entire course (Figs 5-A and 5-B).

In aortic valve lesions the enlargement is at first confined to the left ventricle. The esophagus during this stage is very little affected in its position. As the lesion advances all the heart chambers increase in size. The esophagus is then displaced backward, but seldom to the same degree as in mitral valve disease. When the en-

largement of the heart is associated with dilatation of the aorta, the esophagus is displaced backward and to the left (Figs 6-A and 6-B).

In general enlargement of the heart without aortic dilatation, the esophagus is displaced backward and to the right (Figs 5-A and 5-B). In general enlargement of the heart with aortic dilatation the esophagus is displaced to the left below the arch and backward. The descending aorta is as a rule also found displaced to the left and backward, overlapping the dorsal spine to a more or less degree (Figs 7-A and 7-B).

In congenital heart disease, the position of the esophagus varies a great deal. It may be in normal position, although the anteroposterior diameter of the heart may be greatly increased. Under this condition the anterior chest wall is found to bulge forward, thus compensating for the increase in the size of the heart. More



Fig 8 A Congenital heart disease in which the heart is enlarged, the esophagus is slightly displaced to the right, the hilar region is infiltrated with fibrous deposits (Anterior view)



Fig 8-B The esophagus is moderately displaced backward, the anterior chest wall is bulging forward the anteroposterior diameter of the heart is enlarged (Lateral view)



Fig 9 A The heart is of normal size the aorta is dilated, the descending aorta is displaced to the left the esophagus describes a semicircle around the arch of the aorta below the arch the esophagus is displaced to the left (Anterior view)



Fig 9 B The ascending aorta is dilated and obscures the anterior clear space The descending aorta and esophagus are moderately displaced backward Behind the heart the esophagus is in normal position (Lateral view)



Fig 10 A Large saccular aneurysm arising from the arch of the aorta. The esophagus is displaced to the left (Anterior view)

Fig 10 B The aneurysm is located anteriorly, displacing the esophagus and descending aorta backward. Behind the heart the esophagus is not displaced (Lateral view)

often the esophagus is found to be displaced backward and somewhat to the right, but seldom to the same degree as in acquired lesions (Figs 8-A and 8-B). In one of our cases, the esophagus was only slightly displaced backward, but the heart extended beyond the shadow of the esophagus, descending aorta, and spine. This finding was confirmed by a postmortem examination.

Moderate dilatation of the ascending aorta or arch does not affect the position of the esophagus, but when considerably dilated the esophagus is displaced backward in its upper half. When the arch is dilated the esophagus describes a semicircle, the size of which serves as an indicator to the size of the arch. When the descending aorta is also dilated the esophagus is displaced to the left below the arch and backward (Figs 9-A and 9-B). In the presence of aneurysms, the direction of the displacement of the esophagus will

depend upon the exact origin of the aneurysm. When an aneurysm arises from the ascending aorta or anterior portion of the arch, the esophagus is displaced backward (Figs 10-A and 10-B) when it arises from the posterior portion of the arch the esophagus is displaced forward (Figs 11-A and 11-B). When aneurysms arise from the descending aorta, the esophagus is displaced forward and either to the left or right (Figs 12-A and 12-B). The visualized esophagus enables one to outline an aneurysm to a greater advantage than is otherwise possible. This is especially true in demonstrating fusiform aneurysms of the descending aorta (Figs 11-A and 11-B).

Unless the heart is enlarged, no displacement of the esophagus takes place in simple pericarditis. In the presence of pericardial effusion, the esophagus is only slightly displaced backward, but the cardiac shadow extends beyond the border



Fig 11-A Heart is enlarged aorta is dilated, the descending aorta is displaced to the left, the esophagus is displaced to the left below the arch (Anterior view)



Fig 11-B The ascending aorta is dilated and encroaches upon the anterior clear space. The descending aorta is overlapping the spine, its anterior border is displacing the esophagus forward. Note the fusiform appearance of the aneurysm (Lateral view)

of the esophagus which appears to be enveloped by the latter structure. This is to be expected in the case of a flexible body pressing upon another structure. Recently we had two cases of pericarditis with effusion, in both of which the cardiac shadow extended beyond the esophagus and overlapped the spine (Figs 13-A and 13-B). After recovery, a re-examination of the heart with the visualized esophagus was done. The heart shadow was no longer found to extend beyond the esophagus, thus proving the nature of the cardiac enlargement. The failure to displace the esophagus in the presence of pericardial effusion will enable one to differentiate it from cardiac enlargement due to dilatation or hypertrophy or both, in which the esophagus is invariably displaced backward.

SUMMARY AND CONCLUSION

1 The esophagus occupies a midway position in relation to the anterior and

posterior thoracic wall, dividing the chest into two equal parts. The heart, ascending aorta, and anterior half of the arch are located in the anterior half of the thorax; the posterior half of the arch, descending aorta, spine, and posterior thoracic sulci are located in the posterior half. Enlargement of the heart from any cause will encroach upon the posterior half of the thorax and thus displace the esophagus backward.

2 In pleuro-pulmonary diseases, if the displacement of the heart takes place the esophagus is usually displaced in the same direction. In pulmonary emphysema or kyphosis the distance between the esophagus and dorsal spine is increased.

3 In mitral valve lesions, the esophagus is displaced to the right and backward. The degree of displacement of the esophagus to the right will help to determine to what extent the left auricle contributes to the formation of the right border of the

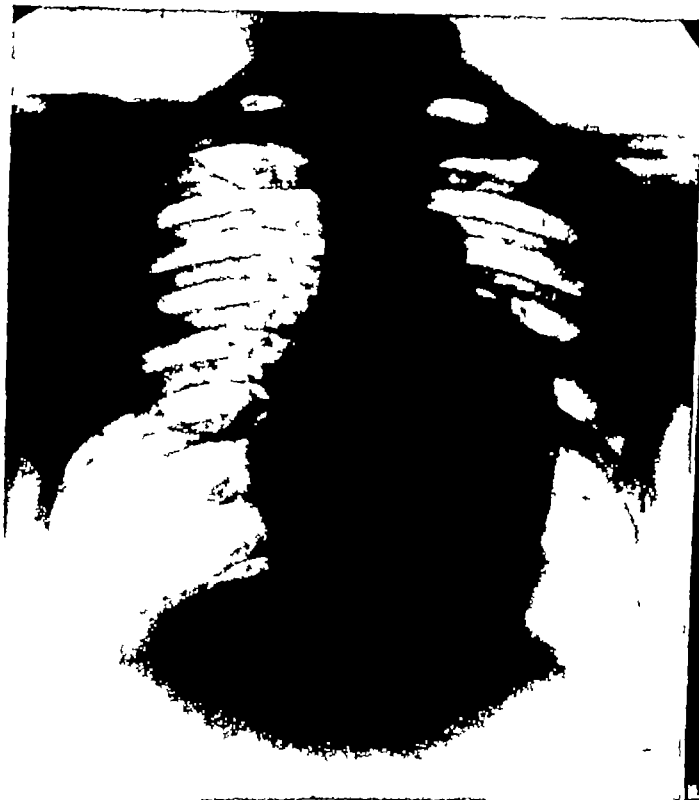


Fig 12 A The configuration of the heart shadow is somewhat peculiar, the esophagus is displaced to the right (not seen on the print) (Anterior view)



Fig 12 B The esophagus is displaced forward by a saccular aneurysm located behind the heart. Note the erosion of the bodies of the dorsal vertebrae (Lateral view)

heart The backward displacement of the esophagus determines the degree of enlargement of the heart in the anteroposterior diameter

4 In aortic valve lesions, the esophagus is displaced to the left and backward. The degree of displacement of the esophagus to the left will help to determine the degree of displacement of the descending aorta to the left. The backward displacement of the esophagus determines the extent of the enlargement of the heart in the anteroposterior diameter and the degree of displacement of the descending aorta to the back.

5 In general enlargement of the heart without aortic dilatation, the esophagus is displaced to the right and backward. In general enlargement of the heart with aortic dilatation, the esophagus is displaced to the left and backward.

6 In congenital heart disease the displacement of the esophagus does not follow any definite rule—it all depends upon the particular defect or defects in the heart and blood vessels. The esophagus is frequently found to be displaced to the right and backward, but seldom to the same degree as in acquired lesions. Very frequently the anterior chest wall is found to protrude forward to compensate for the enlarged size of the heart in the anteroposterior diameter.

7 In the presence of dilatation of the aorta without cardiac enlargement, the esophagus is displaced to the left and backward only behind the great blood vessels. When the heart is also enlarged the esophagus is also displaced behind the heart. In the presence of aneurysms, the position of the esophagus will help to differentiate between aneurysms arising from the as-



Fig 13-A The heart is greatly enlarged toward both sides, the esophagus is in normal position (Anterior view)



Fig 13-B The esophagus is slightly displaced backward behind the heart, the heart shadow extends beyond the shadow of the esophagus as if enveloping it. This was a case of pericarditis with effusion (Lateral view)

ending aorta and anterior half of the arch, and those arising from the posterior portion of the arch and descending aorta. Thus, backward displacement of the esophagus will indicate the origin of the aneurysm to be the anterior portion of the aorta, while forward displacement of the esophagus will indicate the origin of the aneurysm to be the posterior portion of the aorta.

8 In the differential diagnosis between enlargement of the heart and pericardial effusion the determination of the position of the esophagus will prove of great help. In enlargement of the heart as a result of dilatation or hypertrophy or both, the esophagus is invariably displaced backward and either to the left or right. In the presence of pericardial effusion the position of the esophagus is almost unchanged. In the lateral position, the heart shadow is seen to extend beyond the shadow of the esophagus and often also the bodies of the vertebrae.

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DISCUSSION

DR LEO G RIGLER (Minneapolis)

I am pleased to hear the excellent presentation by Dr Brown of this study. It has always been a source of some astonishment to me that the method which he has described has not been more generally used by roentgenologists. Since I first presented our work on this subject in 1929, we have used it consistently in our hospital, and have found it of the greatest value in the diagnosis of diseases of the heart and aorta. The esophagus, filled with barium, gives us an excellent opportunity to delineate the right and anterior borders of the aorta, a matter which is very difficult to do under other circumstances, particularly, as Dr Brown so beautifully shows, in aneurysms of the descending aorta, the procedure is of very great value. My own feeling has been that in aneurysms of the ascending aorta, before the aorta turns into the transverse portion of the arch, the esophagus is very little affected because of the anterior position of this part of the vessel.

I must take issue with Dr Brown, however, upon the question of the value of the esophageal displacement in the differentiation of lesions of the right and left heart. While it is no doubt true that there may be a minor displacement of the esophagus in congenital defects of the heart, even though the lesion is confined to the right side, these displacements are very small in comparison to the general enlargement of the heart. I did not mean to say that there was never any displacement in the right-sided lesions, but the important point is that the displacement is so small in degree in comparison to the general size of the heart, as shown in the postero-anterior view. Obviously, it must be borne in mind in this differentiation that occasionally congenital defects affect the left side of the heart. Not only that, but occasionally acquired heart disease may be confined to the tricuspid or pulmonic valves. Under those circumstances, of course, this differential point does not hold good. Where the lesion is confined to the right side of the heart, whether it be due to a congeni-

tal defect or to chronic disease of the lesser pulmonary circulation, there is very little opportunity for displacement of the esophagus. The reverse is true in those lesions which affect the left side, particularly, of course, mitral valve disease. We have found it to be an important differentiating factor.

I should like to call attention also to what appears to be somewhat of a misconception on Dr Brown's part, which I may be able to clarify. This concerns itself with the point made as to the possibility of distinguishing pericardial effusion from other lesions by the appearance of the shadow of the heart, apparently lying posterior to that of the esophagus in the lateral view. If we recall the appearance of the thorax in a transverse section taken at about the level of the ninth thoracic vertebra, it becomes obvious at once how such a thing could occur from any enlargement of the left heart. The left ventricle enlarges posteriorly, but it lies well to the left of the esophagus, which is exactly in the mid-line. For this reason a posterior enlargement of either ventricle may occur in which the entire dilatation will be completely to the left of the esophagus, in the lateral roentgenogram the enlarged chamber of the heart may thus appear to be posterior to the esophagus without displacing it whatever. It is apparent that no displacement will occur in cases in which the enlargement is well over to one side of the esophagus. It is true that occasionally left ventricular enlargement of marked degree will displace the esophagus. This occurs under such conditions as pull the esophagus over somewhat to the left and the massive enlargement of the left ventricle carries it toward the mid-line and therefore brings it in contact with the esophagus. Under other circumstances, a rather marked enlargement of the left ventricle may occur, causing it to extend far posterior into the shadow of the spine, in the lateral view, without affecting the esophagus whatever.

May I compliment Dr Brown upon his beautiful presentation of this very interesting subject.

APPARATUS FOR SERIAL RADIOGRAPHY AND THE DEMONSTRATION OF THE MUCOSAL RELIEF IN GASTRO-INTESTINAL EXAMINATIONS¹

By JOSEPH C BELL, M D , *Louisville, Kentucky*

AT THE present time there seems to be considerable controversy as to the best type of roentgen examination to use in gastro-intestinal work. Many American radiologists depend largely upon the fluoroscopic examination. Dr Lewis Gregory Cole is the great proponent of serial radiography. The so-called mucosal relief examinations have undoubtedly been employed to some extent by many examiners for years, however, recently Berg, Ak-erlund and others have written extensively on this phase of the subject and have described various types of apparatus for this kind of examination. It is not the purpose of this paper to enter into a discussion of the place of each of the above-mentioned examinations in gastro-intestinal work, but it is my own opinion that all should play a part in most cases.

I believe that serial radiography and the so-called examination of the mucosal relief have not come into general use because of the lack of suitable apparatus that can be adapted to that now in use. I have developed such apparatus in my own work and I thought that it might be of interest to describe it. I make no claim for originality in the principles involved, for many, if not all, of them have been used in equipment which has been described in this country or abroad. I shall include only sufficient illustrations of the films that I am making in order to show some possible applications of equipment of this type.

APPARATUS FOR SERIAL RADIOGRAPHY

Figure 1 illustrates a serial tunnel and tube support in use in the Norton Memorial Infirmary, one of the hospitals with which I am connected. It was built by Mr J W Fowler, the engineer in that institution, at a cost for materials not exceed-



Fig 1

ing thirty-five dollars. As can be seen, the tunnel is mounted with bearings in the tilting table, the bearings resting in the channel irons that ordinarily support a Bucky diaphragm. This particular tunnel is not counterbalanced but can be used upright by raising it and locking it in any position desired. This is not very convenient but is less expensive than one which is counterbalanced. I use the latter type in my office, however, and it has proven most satisfactory.

The tunnel in my office was made by removing the bakelite top from a so-called polygraph² and the metal back was cut out immediately beneath the opening in the lead diaphragm in order that fluoroscopic centering might be done. The polygraph was then mounted in the table with bearings similar to those used in the hospital, as above described. This polygraph has the advantage of having a track which permits films to be made in any position. In order to do so, however, it was necessary to place on the back of the polygraph a small metal angle iron which could be inserted through an opening into the track and thus hold the film carrier in place while the exposure in the left-hand corner of the film was being

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis Tenn., Dec 3-7 1934

² Sold by Picker X ray Corporation

made, with the patient upright. This angle iron is supported by a small rod and spring and can be pushed into the opening or withdrawn very readily. This tunnel has several advantages so far as ease of operation is

not in use. Mr Fowler built this one also, using small thrust bearings which can be locked in place after the tunnel is inserted. I have experienced no difficulty in inserting the apparatus during the examination.

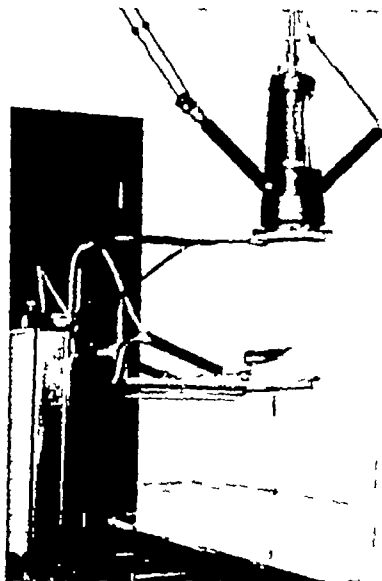


Fig 2

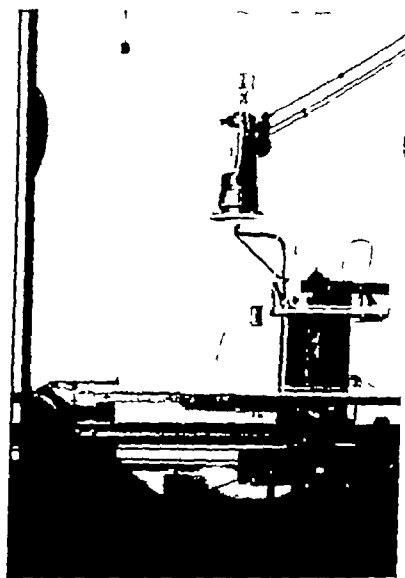


Fig 3

concerned but, of course, is more expensive than the one used in the hospital.

I have a third tunnel, in Saints Mary and Elizabeth Hospital, where the tilting table has a Bucky diaphragm mounted in it. Because of this it was necessary to make an apparatus which could be removed when

This certainly can be done with more ease than would be the case if the apparatus had to be placed directly beneath the patient on the top of the table. It permits serial examinations of very ill patients with the minimum amount of disturbance and effort upon their part.

The area to be examined is centered fluoroscopically and the films are then taken from the opposite direction with a second tube which is above the table. This, of course, reverses the fluoroscopic image, but I find that it does not interfere in any way with the demonstration of a lesion that has been found during the fluoroscopic examination.

The tube support is shown in detail in Figure 2. It was designed by me and built by Mr Fowler. As will be seen, it rests above the fluoroscopic screen and interferes in no way with the usual fluoroscopic examination. When films are desired, after fluoroscopic centering, the tube is moved downward until it is directly over the part

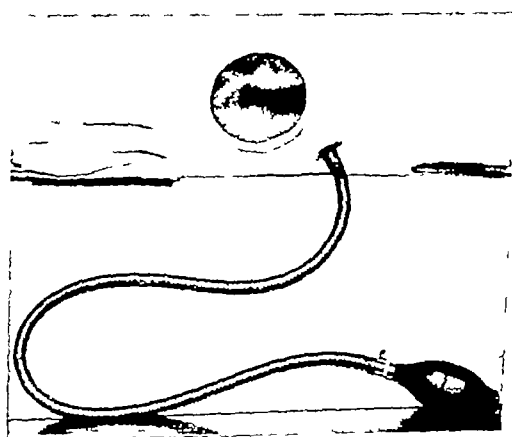


Fig 4.

under observation, and films are then made. In machines with a rail-mounted tube stand attached to the fluoroscope, this tube support is not essential. The radiographic tube may be energized through an overhead two-way switch connecting the generator either to the fluoroscopic or to the radiographic tube or by a separate machine. I use the latter means in my office and the former in the two hospitals with which I am connected.

Figure 3 shows the serial apparatus in the horizontal position.

Figure 4 illustrates a small compression band that was designed to use either with the patient upright or prone. When upright, the band is wrapped about the patient's body and compression made by inflating the small rubber bladder incorpo-

able and will describe further on in this communication.

Many individuals cannot be examined in the upright position and yet, in some of these cases, localized pressure may be of great value in demonstrating lesions. The bladder can be placed beneath the patient in the prone position, or, for that matter, in

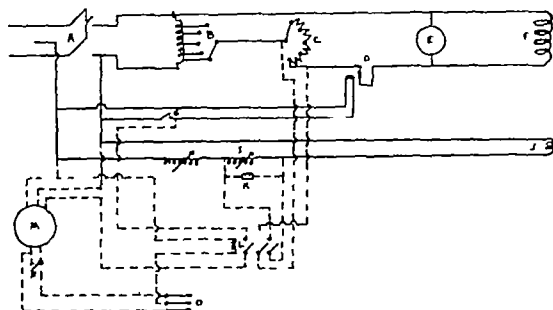


Fig 5

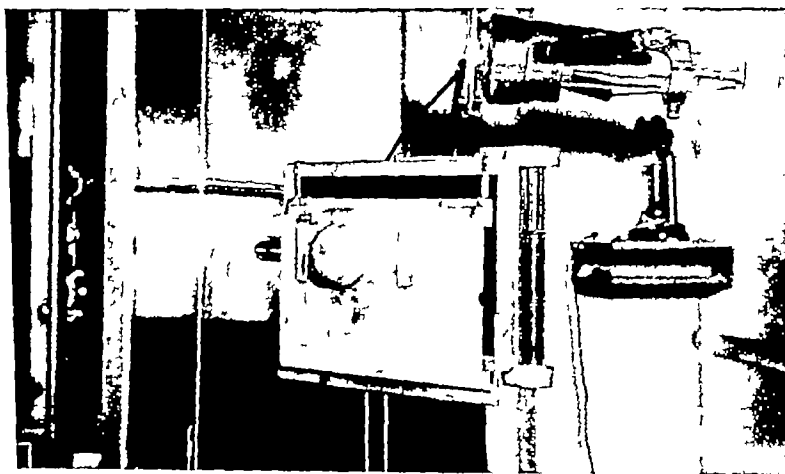


Fig 6

rated in it. As will be seen, the cloth envelope has been cut out on the side next to the patient and an ordinary automobile piston ring inserted into the opening and bound in this position. This is a great aid in localizing the pressure with the fluoroscope and also permits the compression bladder to pouch through the opening, resulting in more sharply localized pressure. This compression apparatus is now seldom used in the upright position because of other apparatus which I now have avail-

any other position. It can be so placed that it lies directly beneath the area to be compressed and then may be inflated until the desired pressure is obtained. Many ulcer craters have been demonstrated most satisfactorily in this manner, together with lesions in the large bowel as well.

One's first impression might be that such an examination would be time-consuming, but I find exactly the opposite to be true. When I finish my fluoroscopic examination, except in special cases, I make eight serial

exposures on two 10×12 films, centering over any area where a lesion has been suspected. In the usual case, unless lesions

prone position, rotated to the right into such a position that the best possible visualization of the distal half of the stomach

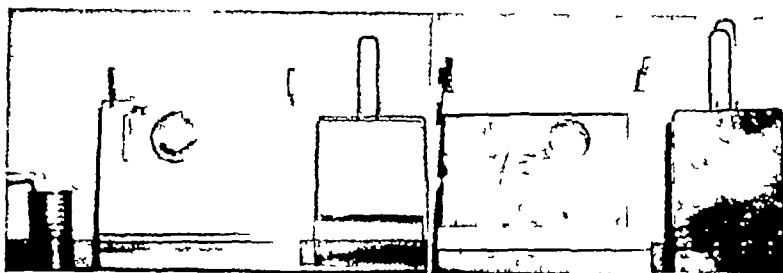


Fig 7

Fig 8

are noted in other parts, I center over the distal half of the stomach and the duodenum, for the large majority of gastric and duodenal lesions will be found in this area

and duodenum will be obtained. I also make a single exposure of the entire stomach and duodenum in the direct prone position, generally using an 8×10 film.



Fig 9

Films may then be made with the patient rotated into any position and at any angle from the upright to the Trendelenburg. Usually, however, they are made with the table horizontal and the patient in a semi-

THE MUCOSAL RELIEF EXAMINATION

I have been interested for several years in the so-called mucosal relief type of examination, described by Berg, but until re-

cently have not had satisfactory apparatus for this examination. A short time ago I visited the Massachusetts General Hospi-

tal and had the privilege of observing the work that is being done in that institution by Dr. Richard Schatzki and Dr. George Holmes. I was more than ever convinced of the value of this examination when I saw their work and heard Dr. Schatzki discuss the subject at the Pittsburgh meeting of the American Roentgen Ray Society.



Fig 10

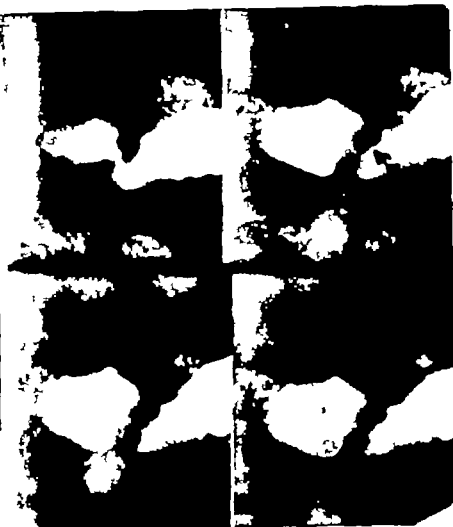


Fig 11

The apparatus that I am about to describe demonstrates beautifully the mucosal relief in most individuals, yet there are some in whom it cannot be used because of the position of the parts to be examined. It has no place in the examination of many acutely sick individuals, such as are frequently encountered in a general hospital practice.

When I became interested in the mucosal relief type of examination I experienced my greatest difficulty in switching over from the fluoroscopic to the radiographic setting after a lesion had been located with the fluoroscope. This was done by hand for a time, but was not satisfactory. Recently Mr. Walter L. Abernathy¹ has built an apparatus for me which permits instantaneous switching from the fluoroscopic to

the radiographic setting, and *vice versa*. The principles involved are undoubtedly well recognized, but, so far as we are concerned, they are original with us. I have always run my fluoroscope with considerable resistance in the primary circuit because, by so doing, tubes seemed to last much longer. It occurred to me that, with a suitable switch, this resistance might be short-circuited and thus prevent a drop in the voltage when the tube current was changed from that used for fluoroscopy to the radiographic setting. I planned to change the current by inserting resistance in the Coolidge circuit in such a way that this could be short-circuited at the same time as the rheostat. Mr. Abernathy suggested that we place a second Coolidge choke coil in series with the regular coil in the Coolidge circuit, for, he believed, this would be much more efficient than resistance. He also suggested that he wire my regular timer into the circuit in order that the exposure could be controlled accurately.

Figure 5 shows the wiring in the apparatus that we have made. The heavy black lines show in a simple diagrammatic manner the usual primary circuit of an x-ray machine, together with the Coolidge circuit and the circuit operating the remote

¹ Of the Dick X-ray Company, of Louisville, Ky.

control magnetic contactor. The broken lines represent the wiring and apparatus that have been added by us. *A* is the main

of the wiring is in the low tension circuit. It may seem somewhat complicated, but in actual operation it is very simple.



Fig 12

control switch of the x-ray machine, *B* is the autotransformer, *C*, the rheostat, *D*, the remote control magnetic contactor, *E*, the kilovolt meter, *F*, the primary winding of the x-ray transformer, *G* is the exposure switch operating the 110-volt remote control magnetic contactor, *H* is the first filament choke coil (of the inductive type), *I* is the second coil (of a similar type), wired in series with the first coil, *J* represents the primary winding of the filament transformer, *K* is a single pole switch to short-circuit the second Coolidge choke coil at any time that one may desire to cut it out of the circuit (rarely used, however), *L* shows a triple pole magnetic contactor, *M* is the motor-driven timer (exposures ranging from 1/20 to 20 seconds), *N* is the timer exposure button, and *O* represents a three-contact switch. As will be seen, all

Operation—The choke coil (*H*) is adjusted so as to give the proper filament current for radiography. This can be done by cutting out the second Coolidge choke coil with the hand switch labeled *K*. The second Coolidge choke coil is then placed in the filament line with the hand switch and is so adjusted that the proper fluoroscopic current is obtained. When fluoroscoping, the magnetic contactor is in the open position indicated in the diagram. When the three-contact switch, labeled *O*, is closed half-way, the holding coil (*L*) is energized, closing the triple pole contactor, which automatically cuts out all resistance and short-circuits the second choke coil, thus raising the milliamperage to that used for radiography. The switch also connects the return wire from the motor-driven timer to the holding coil on the main x-ray trans-

former. When the three-contact switch, labeled *O*, is completely closed, the motor-driven timer is energized and any predeter-

will also answer the requirements. The effective focal area of these tubes is approximately the same as the old 30-mili-

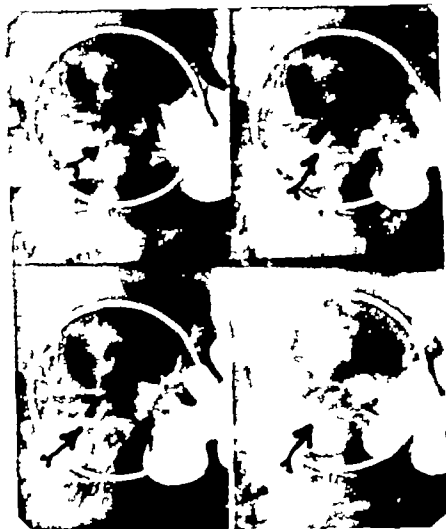


Fig 13

mined exposure may be made. As can readily be appreciated, all of these changes take place almost instantaneously, and I have worked with the apparatus sufficiently long to know that the results are satisfactory. The switch (*O*) may be operated either with the foot or with the hand. I have used both methods but prefer to have the switch attached to the handle that shifts the film into position.

The cost of material for this apparatus is slight and the labor involved in making it certainly not excessive. It is not absolutely necessary to have the timer wired into this circuit, for the exposures can be controlled by the examiner without a timer. This may be of some advantage, for it permits variation in the exposure time with changes in the patient's position, without resetting the timer.

In order to do work of this type it is necessary to use a tube with sufficient capacity for the higher exposures. I have found that the Machlet CYR-C tube and the tube made by the General Electric Company, of a similar capacity, to be very satisfactory, and I believe that the Westinghouse Company is now building one which



Fig 14

ampere radiator type Coolidge tube and it was always considered a very satisfactory one for fluoroscopy.

In my machine the amount of resistance in the rheostat is such that when it is short-circuited and the current changes from that suitable for fluoroscopy to that used in radiography there is practically no change in voltage due to the heavier load. In fluoroscopying a very heavy patient, I am likely to do so at approximately 80 peak kilovolts and a current of 4 milliamperes. When the change is made to radiography I will secure approximately the same kilovoltage with a current of 70 milliamperes. On smaller patients I usually employ a much lower penetration for fluoroscopy and a correspondingly low penetration when making films. This is regulated by the autotransformer setting, as would be done with an ordinary machine. The exposure time varies from two-twentieths of a second in small patients up to one-half second in very large ones. If it is desirable to have a greater spread between the kilovoltage used in fluoroscopy and in radiography, this is readily obtained by adding secondary resistance coils to the rheostat.

Figure 6 illustrates the film tunnel used

control magnetic contactor. The broken lines represent the wiring and apparatus that have been added by us. *A* is the main

of the wiring is in the low tension circuit. It may seem somewhat complicated, but in actual operation it is very simple.



Fig 12

control switch of the x-ray machine, *B* is the autotransformer, *C*, the rheostat, *D*, the remote control magnetic contactor, *E*, the kilovolt meter, *F*, the primary winding of the x-ray transformer, *G* is the exposure switch operating the 110-volt remote control magnetic contactor, *H* is the first filament choke coil (of the inductive type), *I* is the second coil (of a similar type), wired in series with the first coil, *J* represents the primary winding of the filament transformer, *K* is a single pole switch to short-circuit the second Coolidge choke coil at any time that one may desire to cut it out of the circuit (rarely used, however), *L* shows a triple pole magnetic contactor, *M* is the motor-driven timer (exposures ranging from 1/20 to 20 seconds), *N* is the timer exposure button, and *O* represents a three-contact switch. As will be seen,

Operation—The choke coil (*H*) is adjusted so as to give the proper filament current for radiography. This can be done by cutting out the second Coolidge choke coil with the hand switch labeled *K*. The second Coolidge choke coil is then placed in the filament line with the hand switch and is so adjusted that the proper fluoroscopic current is obtained. When fluoroscoping, the magnetic contactor is in the open position indicated in the diagram. When the three-contact switch, labeled *O*, is closed half-way, the holding coil (*L*) is energized, closing the triple pole contactor, which automatically cuts out all resistance and short-circuits the second choke coil, thus raising the milliamperage to that used for radiography. The switch also connects the return wire from the motor-driven timer to the holding coil on the main x-ray trans-

former. When the three-contact switch, labeled *O*, is completely closed, the motor-driven timer is energized and any predeter-

will also answer the requirements. The effective focal area of these tubes is approximately the same as the old 30-milli-



Fig 13

mined exposure may be made. As can readily be appreciated, all of these changes take place almost instantaneously, and I have worked with the apparatus sufficiently long to know that the results are satisfactory. The switch (*O*) may be operated either with the foot or with the hand. I have used both methods but prefer to have the switch attached to the handle that shifts the film into position.

The cost of material for this apparatus is slight and the labor involved in making it certainly not excessive. It is not absolutely necessary to have the timer wired into this circuit, for the exposures can be controlled by the examiner without a timer. This may be of some advantage, for it permits variation in the exposure time with changes in the patient's position, without resetting the timer.

In order to do work of this type it is necessary to use a tube with sufficient capacity for the higher exposures. I have found that the Machlet CYR-C tube and the tube made by the General Electric Company, of a similar capacity, to be very satisfactory, and I believe that the Westinghouse Company is now building one which



Fig 14

ampere radiator type Coolidge tube and it was always considered a very satisfactory one for fluoroscopy.

In my machine the amount of resistance in the rheostat is such that when it is short-circuited and the current changes from that suitable for fluoroscopy to that used in radiography there is practically no change in voltage due to the heavier load. In fluoroscopying a very heavy patient, I am likely to do so at approximately 80 peak kilovolts and a current of 4 milliamperes. When the change is made to radiography I will secure approximately the same kilovoltage with a current of 70 milliamperes. On smaller patients I usually employ a much lower penetration for fluoroscopy and a correspondingly low penetration when making films. This is regulated by the autotransformer setting, as would be done with an ordinary machine. The exposure time varies from two-twentieths of a second in small patients up to one-half second in very large ones. If it is desirable to have a greater spread between the kilovoltage used in fluoroscopy and in radiography, this is readily obtained by adding secondary resistance coils to the rheostat.

Figure 6 illustrates the film tunnel used

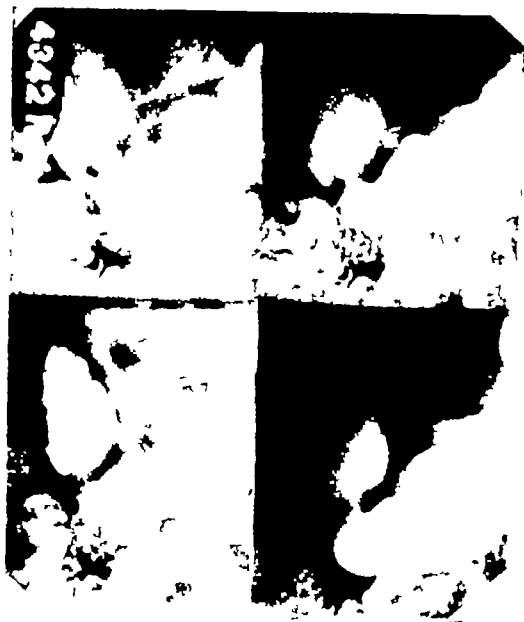


Fig 15

in my work when attached to the fluoroscopic screen, with the fluoroscope in the upright position. Figure 7 shows in detail the two parts of the serial tunnel, the tunnel itself, and the cassette carrier. The counterbalancing weight is also shown. It is so made that it can be suspended on the regular counterbalance of the fluoroscopic screen from a pin that is set in the counterbalance. Figure 8 shows the same parts of the apparatus except that the tunnel is viewed from the opposite direction. When not in use the counterbalance and tunnel are kept in a convenient place and at any time may be attached to the machine for use in an instant. After suspending the tunnel from the fluoroscopic screen an 8×10 cassette is inserted into the carrier shown and is moved to the left so that it rests behind the lead protection ready for use.

The patient is placed behind the upright fluoroscopic screen facing the examiner and is then directed to take one or two swallows of a heavy suspension of barium in water. The examiner makes pressure over the stomach or duodenum with the hemisphere of the apparatus by moving the fluoroscopic screen and apparatus toward

the patient's abdomen with his left hand. The pressure brings the mucosal folds into sharp relief and all parts may be examined under careful fluoroscopic control. The fluoroscopic image is seen on the regular fluoroscopic screen in front of the opening in the lead shield of the serial apparatus. When a lesion is noted or a questionable area found, pressure is maintained with the left hand, the fluoroscopic switch is opened, the film is shifted into place with the right hand, and the patient told to stop breathing. The change from the fluoroscopic to the radiographic setting is made, together with the exposure, by pressing the small button of a switch incorporated into the handle of the carrier.

It is surprising how slight is the pressure necessary to bring the mucosal folds into sharp relief in most individuals, and how easily lesions may be demonstrated when they are seen during the fluoroscopic examination. It would be possible to make serial exposures without changing the pressure, but I usually readjust the pressure under fluoroscopic control after each exposure. I have seldom failed to demonstrate a lesion noted with the fluoroscope in most of the films, regardless of the change in the amount or direction of the pressure.

It is a matter of choice how many exposures should be made but usually four are sufficient. If one is examining the duodenum, exposures may be made in various positions, including a direct postero-anterior view, together with exposures in both right and left oblique projections. In the apparatus used by Dr. Schatzki the aluminum hemisphere can be removed and exposures made without any pressure, by placing the opening in the cylinder of the apparatus directly over the region to be examined. I have made use of this in my apparatus and it is of value in showing abnormalities in the contour of the duodenal bulb or defects in the margin of the gastric shadow.

I thought of making an automatic locking device which would maintain just the right amount of pressure after it has been secured, but have not done so because this

seems unnecessary with the type of apparatus that I employ. The design of such a device would be rather simple but it complicates the operation.

the film in the left upper corner of the illustration. The patient has been in relatively good health since the operation.

Figure 12 shows a deep penetrating ulcer

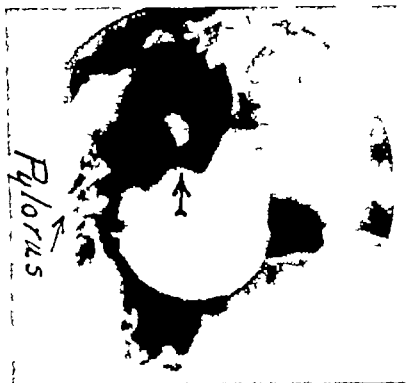


Fig 16



Fig 17

ILLUSTRATIONS OF SOME OF THE FILMS THAT CAN BE MADE WITH THE APPARATUS ABOVE DESCRIBED

Figure 9 shows serial films of the distal part of a normal stomach and duodenum. These films show the various phases of peristalsis and, in my opinion, are very valuable in determining the flexibility or lack of it in the gastric or duodenal walls. If, during the fluoroscopic examination, one waits until barium passes out of the stomach and fills the first portion of the duodenum, it is rare not to secure at least one satisfactorily filled first portion in the serial films and frequently this portion is well filled in all of them.

Figure 10 shows a diverticulum of the descending portion of the duodenum in serial films. Figure 11 shows the distal third of the stomach and the first portion of the duodenum in serial films. As will be noted, there is a constant niche-like irregularity just proximal to the pylorus, which was reported to be an organic lesion, whether benign or malignant could not be determined with absolute certainty. At operation this was found to be an ulcer and was considered to be benign. A second very small ulcer was found directly in the pyloric channel. This ulcer probably is shown by the irregularity to be seen in the pyloric channel in

of the lesser curvature near the junction of the proximal and middle third of the stomach, presumably benign in nature. Re-examination some two months later, after the patient had been under medical treatment with rest in bed, showed no evidence of an ulcer crater at this point.

Figure 13 shows four serial exposures, made with the patient prone, with localized pressure over the first portion of the duodenum. A definite ulcer crater can be seen in each of the exposures.

Figure 14 is a gastric mucosal relief film. This shows a relatively deep penetrating ulcer which was located in the posterior wall of the middle third of the stomach approximately 2 cm. to the right of the lesser curvature. This could not be shown in profile in any position in which the patient could be examined. I do not believe that it could have been demonstrated in ordinary films, but was shown very graphically in each of eight exposures made with the second serial apparatus above described.

Figure 15 shows serial films of the first portion of the duodenum in which no generalized deformity could be noted in either of the oblique positions or in the direct postero-anterior or anteroposterior views. In the serial films there is slight flattening of the posterior wall of the duodenum and in two of the films a slight irregular-

ity can be seen near the apex, but I do not believe that this is due to an ulcer crater. Figure 16 was made with the second apparatus described, in the same patient as Figure 15, a definite ulcer crater can be seen in the posterior wall of the first portion of the duodenum, indicated by the arrow. This ulcer was shown in each of eight exposures. Many of the exposures show swelling of the mucosa about the ulcer crater. At the time of the examination the patient was having severe symptoms in keeping with those found in an active duodenal ulcer.

Figure 17 shows the mucosal relief of the first portion of the duodenum, made with the second apparatus described. The first portion of the duodenum was greatly deformed, the changes being characteristic of

those seen in an individual with an ulcer. There is marked scarring of the mucosa immediately beyond the pylorus in this film, but no ulcer crater can be seen. The pouch-like deformity on the lesser curvature side is, I believe, due to folding of the wall of the duodenum and not to a crater. The patient previously had symptoms of a duodenal ulcer but they were absent at the time of the examination and had been so for some time.

COMMENT

The illustrations presented are relatively few in number and form only a small part of the material that I have available. I am including them only to show some of the possible uses of the apparatus above described.

A RADIO FREQUENCY HIGH VOLTAGE APPARATUS FOR X-RAY THERAPY¹

By ROBERT S. STONE, M.D., M. STANLEY LIVINGSTON, Ph.D., DAVID H. SLOAN, M.S.,
and MILTON A. CHAFFEE, A.B., San Francisco

Division of Roentgenology of the Medical School and the Radiation Laboratory of the Department of Physics, University of California²

INTRODUCTION

DURING the development of the high voltage technique for nuclear disintegration purposes in the Radiation Laboratory of the University of California, under the direction of Professor Ernest O. Lawrence, one of the authors (D.H.S.) devised and constructed an apparatus for pro-

ducing high voltages by the use of a radio frequency resonance transformer in vacuum. This method was announced in the "Physical Review" (1) and was amplified in another article, soon to appear. Tests showed that peak voltages of from 700 to 1,000 kilovolts could be obtained and, when a suitable filament was installed, x-rays

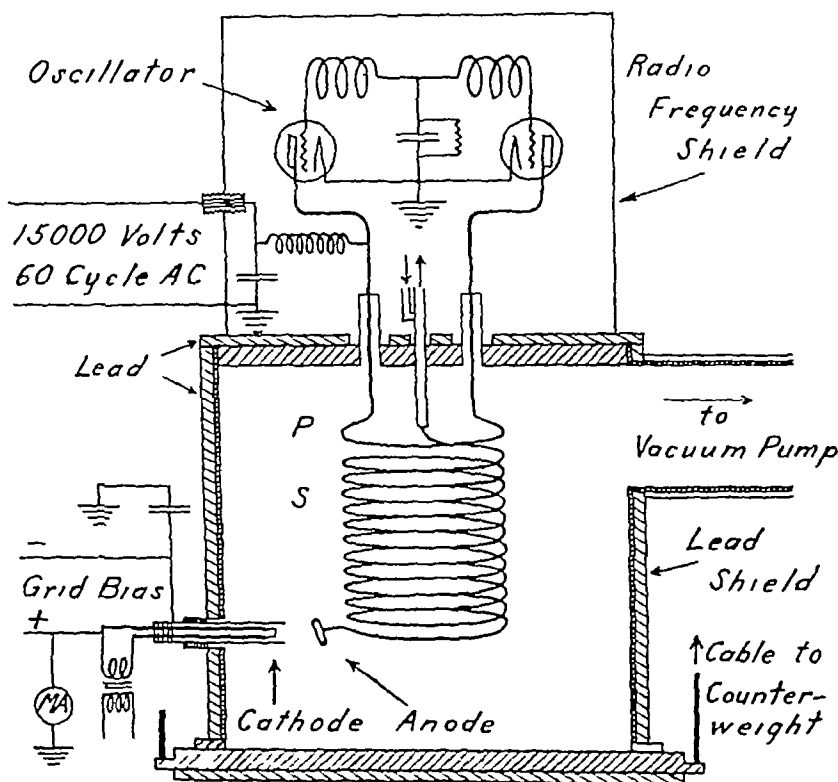


Fig. 1 Diagrammatic representation of the tube and circuit

¹ Presented before the Radiological Society of North America at Memphis, Tenn. Dec. 3-7 1934.

We wish to acknowledge the generous support of Mr. William H. Crocker of San Francisco which has made this installation possible. The Christine Breon Fund for Medical Research has contributed some of the funds for the investigations. The original development of the method was largely supported by the Chemical Foundation and the Research Corporation. The advice and assistance of Prof. L. O. Lawrence of the Dept. of Physics and Prof. H. I. Ruggles of the Division of Roentgenology, have been of inestimable value.

with this range of peak energies were obtained. When it became evident that such an apparatus could be made sufficiently practical, arrangements were made to install one in the University of California Hospital, in San Francisco, for the treatment of patients. This particular installation is described in the present article.

PART I—APPARATUS

Principle—A very high power short wave radio oscillator sends its power into the high voltage resonant circuit instead of

into the usual transmitting antenna. This high voltage resonance transformer is a helical spiral of about twelve turns of copper pipe, without insulation, supported by the upper end which is grounded to the roof of



Fig 2 Photograph of the tube, showing the oil pumps

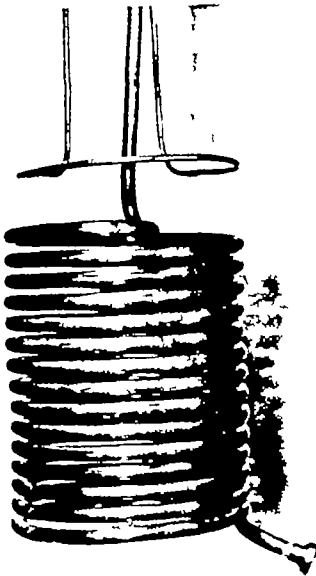


Fig 3 Photograph of the primary and secondary coils outside of the tank

the surrounding copper-walled vacuum tank. The coil, with its capacity to the walls, forms a quarter wave length resonant circuit with a voltage node at the top support and a voltage maximum at the bottom end which supports the x-ray target. The high voltage thus is produced entirely within the vacuum, exactly where it is to be used, and is free from all insulating material. Figure 1 shows the high voltage coil in the vacuum tank.

Description—The vacuum tank which serves both as container for the transformer and as the x-ray tube, is cylindrical in shape, 42 inches in diameter and 40 inches high, with walls of three-eighths of an inch steel and end plates of 2-inch steel, the lower one of which is removable (Fig 2). The tank is supported by having the top plate bolted to channel beams crossing the room with the ends securely mounted in the walls. A steel ring forms a ledge around the bottom of the tank and serves the double purpose of supporting the necessary lead for shielding and furnish-

ing a machined face for a rubber-gasket tongue-and-groove vacuum seal for the bottom plate. This is supported by counterweights and can be lowered, to give access to the interior. A large pipe for a

etc., are welded into the tank. Electric welding is used throughout.

The 10-inch pump manifold carries four brass Apiezon Oil pumps, 4 inches in diameter, with a total pumping speed of 300

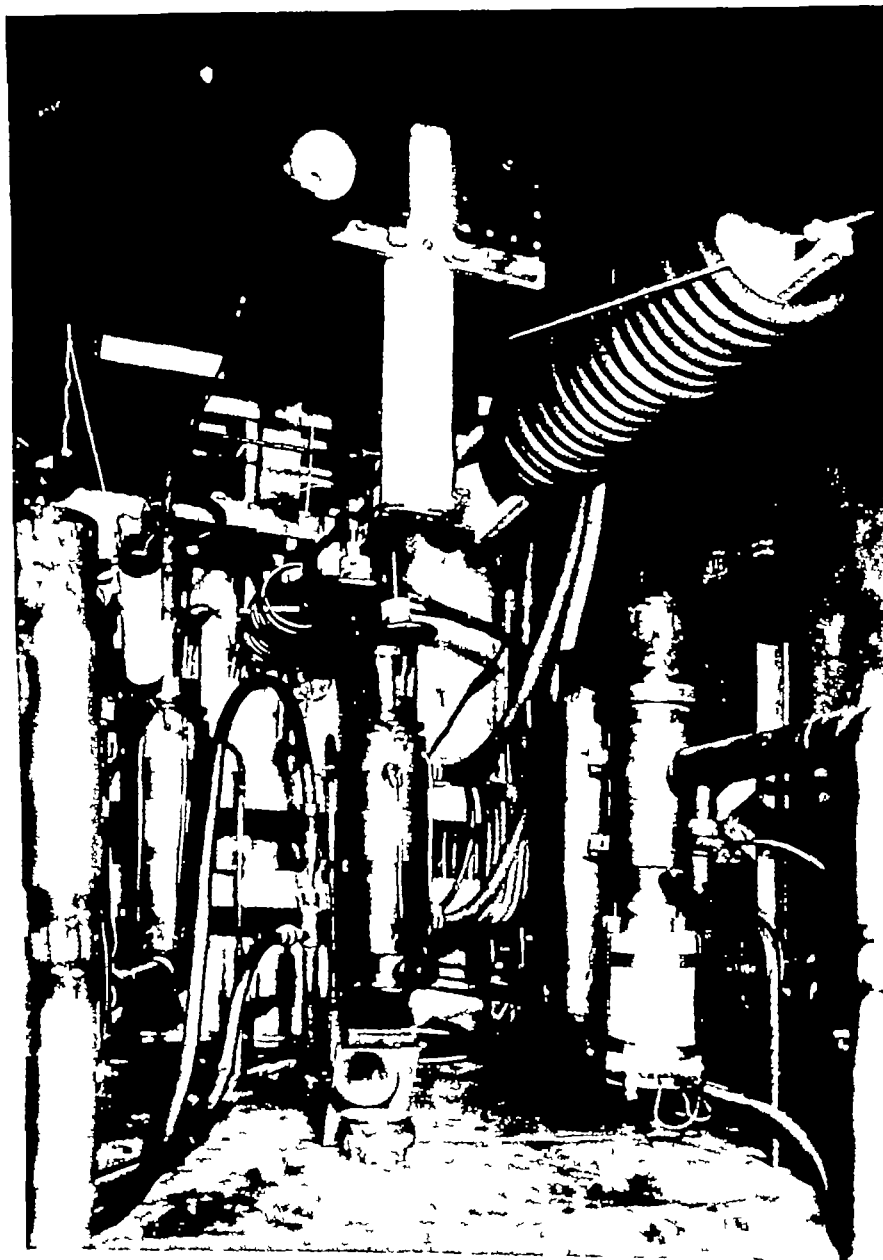


Fig. 4 Photograph of the essential parts of the oscillator tubes and circuit

pumping outlet and smaller ones for mounting the x-ray filament, primary coil insulators, main coil supports, windows,

liters per second, and has one 4-inch pump for the second stage and a Cenco Hypervac for rough vacuum. Suitable ionization

gauges and Pirani gauges are used to measure pressures, which are in the order of 10^{-3} mm of mercury in the tank. Sealing wax is used for vacuum seals wherever ease of assembly is required.

A water-cooled copper lining is used inside the tank to provide low electrical resistance for radio frequency currents. For the high voltage secondary coil, seven-eighths of an inch copper pipe is wound into a spiral about 15 inches in diameter and of 12 to 15 turns, in such a manner that when supported from the top, the turns hang freely about three-eighths of an inch apart (Fig. 3). Inside of the main copper pipe is a smaller pipe covered with heat-insulating material to allow a circulation of water for cooling the coil and the target at the lower end, which is an internally cooled copper block with either a tungsten or a gold face. The upper end of the coil is supported by a clamp at the top of the tank so that the cooling water for the high voltage target enters and leaves at ground potential. Instead of connecting the oscillators directly, they are inductively coupled to the high voltage coil by a primary coil of one or two turns of tubing of the same diameter as the secondary coil. This primary coil is made of copper tubing three-eighths of an inch in diameter and is water-cooled. It is supported by leads which pass through pyrex glass insulators at the roof of the tank. The spacing between the primary coil and the secondary coil is adjustable. This controls the voltage "step-up" and is necessary for the exact tuning of the oscillating circuit to give the highest voltages.

The x-ray filament assembly differs from those in routine use. The filament itself is a straight tungsten wire in the vertical plane. This straight wire filament is recessed 2 mm back from the open end of the surrounding grid. This shield, or grid, is connected in a separate circuit so that it can be maintained at a desired negative potential of several thousand volts. This negatively charged grid close to the source of the emission of electrons prevents their escape until the target reaches a very high positive potential. Thus, by proper adjustments, the

x-ray output can be made to simulate that from constant potential direct current. This filament assembly is mounted through the side of the tank directly opposite the face of the target.

The two radio frequency power oscillator tubes were specially designed to give the required power at the operating frequency of 6,000 kilocycles, or 50 meters wave length. In each tube six 0.05-inch tungsten filaments 8 inches long are supported with individual spring tension to allow for expansion in such a manner that they are easily replaceable. Each grid is a helix of small copper wire wound on and soldered to six water-cooled copper tubes. Each anode is made of copper pipe 4 inches in diameter, with a brass water jacket, which allows a thin sheet of rapidly moving water to cool the anode. Each is pumped continuously by one 4-inch Apiezon Oil pump connected through insulating quartz tubing. The water for cooling the various circuits is circulated through rubber hose reels for voltage insulation. The grid is spaced from the filament and from the anode by glass cylinders which are sealed to the metal parts by wax joints and form part of the vacuum envelope of the tube.

The oscillators work into a "push-pull," "tuned-plate-tuned-grid" circuit, the ends of the primary coil being directly connected to the anodes of the two tubes. A separate grid coil is adjustable for tuning. Grid bias is supplied by a grid leak and condenser, while the anode is supplied by from 10,000 to 16,000 volts of 60 cycle alternating current power. Filters in the wires entering the copper box which completely surrounds the oscillating circuit, avoid the radiation of radio waves. This circuit is shown diagrammatically in Figure 1, and pictorially in Figure 4.

Protection of the operators and patients from the direct high voltage x-rays is accomplished by surrounding the walls of the tank with 1.5 inches of lead with an extra half-inch in thickness on the operator's side. This is installed on the tank by having sheets of lead one-quarter of an inch thick wrapped around the tank and supported by

the ledge mentioned previously. The 2-inch steel plates of the top and bottom of the tank are augmented by 1 inch of lead. Portals for x-ray treatments are cut through the lead and also through the walls of the

covered with lead one-eighth of an inch thick, and, in addition, the operators' control bench in the adjoining room is lined on sides and floor with lead one-fourth of an inch thick. Tests made with a suitable



Fig 5 (*upper*) Photograph of a port showing the lead shutters to the right and above and the filters partly removed on the left

Fig 6 (*lower*) Photograph of the tube from the opposite side to that shown in Figure 2 showing two patients set for treatments

tank, over which steel plates one eighth of an inch thick are welded. To protect the operators from the relatively low voltage scattered radiation when the ports are open for treatment, the walls of the room are

ionization chamber show the residual rays to be well within a safe limit for continuous operation for the voltages noted in this paper

The four treatment ports are arranged

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ionization chamber show the residual rays to be well within a safe limit for continuous operation for the voltages noted in this paper.

The four treatment ports are arranged

with sliding lead shutters one inch thick to give any desired rectangular or square aperture (Fig 5). A slot for holding lead and copper filters is arranged on each port. Removable aluminum cones are provided to locate the treatment area on the patient. The ends of these cones are exactly 70 cm from the target. One port giving a maximum treatment area of 22 by 22 cm is directly below the target, two ports 15 by 15 cm are placed on a horizontal level, and one port 18 by 18 cm is directed downward 30 degrees from the horizontal. Two motor-driven cots and three motor-driven chairs are used to place the patients in position opposite the ports (Fig 6).

Operation—In operation, the apparatus is remarkably stable. High voltage discharges in the tank occur between metal surfaces and are harmless. They sometimes liberate sufficient gas from the metal walls to overload the oscillating circuit and force it to cease oscillating. This automatically stops the high voltage, and relays in the supply circuits, which are properly set for a small overload, open a circuit-breaker in the supply lines. A few seconds are usually ample for the pumps to evacuate this gas and the oscillations can be started again. Discharges of this nature occur normally in conditioning the apparatus for high voltages, but are rare when a stable operating condition is reached. In daily operation it is customary to have one or two such flashes during the five or ten minutes required to bring the apparatus up to the operating voltage at the start of the day. Neon glow lamps are attached to the oscillating circuit to indicate oscillations, and the glow flickers or disappears during such discharges.

The coil requires over 200 K W to generate 800 K V, but by using 60 cycle power to supply the oscillator anodes, this maximum is attained only during a small fraction of the cycle. The average power consumed produces heat in the coil at the rate of only 30 K W when generating 800 K V. On such a half-wave load as this, the power factor is low. A special design of transformer is used to supply the power. It has

a 125 K V A rating but only 75 K W is consumed while actually operating at 800 K V. An additional 15 K W is continuously used throughout the operating day on auxiliary circuits.

The chief criticism of this type of apparatus has concerned its electrical inefficiency, and many have believed the power consumption to be formidable. It seems necessary to point out that, although the power consumption is somewhat greater than for other installations giving similar voltages, the cost of power is less than the salary of an operator or nurse and is a small part of the operating budget. Since the cost of power is such a minor item of operating expense, it has not been considered expedient at this time to provide the apparatus with one of three improvements, any one of which will reduce the cost of electric power per unit to a value almost as small as the cost by conventional x-ray tubes. These schemes consist simply of enormously increasing the intensity of the radiation for a much shorter period of use, which decreases the power wasted by the radio equipment directly in proportion to the decreased time of operation. Should a situation arise in which the cost of power is a more appreciable fraction of the over-all operating expenses, one of these schemes may be applied easily.

General Remarks—The apparatus is rugged to an extreme, with its welded steel vacuum tank serving both as an x-ray tube and a high voltage insulator for the transformer. Punctures such as occur in glass or porcelain x-ray tubes are impossible. High voltage discharges, which are certain to occur when increasing the voltage applied to any apparatus, are confined in a metal chamber where no damage can result. Whenever a discharge takes place, the inherent characteristics of the circuit are such that the voltage on the coil drops to nearly zero, and a circuit-breaker then opens the power supply lines. In other words, it automatically protects itself from continued discharge, and far from causing damage, the high voltage discharges merely clean the all-metal surfaces so that even greater

voltages may be applied. Because of the absence of any exposed high voltage conductors, the installation can be made in a room of ordinary size, instead of requiring a large building to surround it.

The replacement of parts which burn out, such as filaments and targets, is extremely

simple and inexpensive and usually the apparatus can resume operation again the same day.

REFERENCE

(1) SLOAN, D. H. Phys. Rev., 1933, **43**, 213, 1935
47, 62

(End of Part I)

RENAL TUBERCULOSIS¹

A PLEA FOR EARLY DIAGNOSIS

By CARL J. BUCHER, M.D., Assistant Director of Clinical Laboratories, and THEODORE R. FETTER, M.D., Chief of Clinic, Department of Urology, Philadelphia

From the Urologic Department and Clinical Laboratories of the
Jefferson Medical College Hospital

ADVANCEMENT in the diagnosis of phthisis has steadily progressed since the classic description of its lesions by Ballie and Laennec. Clinical medicine has improved its methods of examination, while pathology, bacteriology, and roentgenology have added brilliant chapters to the study of pulmonary tuberculosis. As a result the phthisical patient is recognized sooner and consumption is not now the hopeless disease it was a few years ago.

The advances in the diagnosis of renal tuberculosis have lagged behind those of phthisis. There are many reasons for it: the disease is more insidious, the symptoms are often minimized, and the physical signs are not appreciated by the doctor. The chief reason, however, is that all of us have been less concerned with an early diagnosis of renal tuberculosis than with that of phthisis.

The pathogenesis of phthisis is quite well understood. The contributions of Ghon (1), Ranke (2), Aschoff (3), Tendeloo (4) and others have given us a clear conception of the primary lesion, its progression, spread, and effect on modifying the course and anatomical changes of a reinfection. Notions regarding the pathogenesis of renal tuberculosis are not so clear. In the mass of conflicting literature there seems to be fairly definite agreement that a tuberculous lesion of the kidney is never primary—that it is always produced by organisms brought to the kidney from a lesion elsewhere. Certain embolic lesions of the renal cortex and miliary tuberculosis are brought about by a hematogenous dissemination. The

manner in which the tubercle bacilli produce tuberculous pyelitis, papillitis, and diffuse caseous tuberculosis of the pyramids—renal phthisis—is still debatable. There are those, like Huebschmann (5) who say that the hematogenous route of dissemination is the only one deserving serious consideration. Tendeloo (4) advances some good arguments to support his view that these lesions begin about the renal papilla and are of lymphogenous origin. Aschoff (6) includes in a discussion on the subject a description of the mechanism of ascending infection, while Stoerck (7) points out that if ascending infection occurs, we ought to be able to demonstrate the progress of the lesions from below upward.

Two questions of importance bearing on the early diagnosis of renal tuberculosis are: (1) does a sound kidney excrete tubercle bacilli and (2) do renal lesions heal spontaneously? That a sound kidney does not excrete tubercle bacilli is well proven by the brilliant and careful researches of Dimtza and Schaffhauser (8), Medlar and Sasano (9), and Lieberthal and Huth (10). It follows that tubercle bacilli in the urine mean a tuberculous lesion in the urogenital tract. That some healing occurs has been demonstrated by Medlar (11). It is, however, not of such a degree as to exclude the need for surgery except in the miliary variety or in cases in which both kidneys are tuberculous.

The crucial question in the early diagnosis of renal tuberculosis, once a renal lesion has been demonstrated, is: is it tuberculosis and how extensive is the damage? Any answer worth while must be deduced by the combined methods of urology, the laboratory, and of roentgenology.

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis, Tenn., Dec. 3-7, 1934.

The laboratory has three methods of approach to the problem the stained smear from the urinary sediment, the cultural method, and the inoculation of animals with the suspected material. All three are valuable, and all three have limitations with which all concerned should be acquainted. The smear made from urinary sediment and stained for tubercle bacilli has the disadvantage that one demonstrates only acid fast bacilli. By itself, it can readily lead into error. The guinea pig method is of more value—it demonstrates, when positive, that tuberculosis is present. One gets some idea too, of the virulence of the organism. The method often fails because animals die of intercurrent infection or of one introduced with the tuberculous material.

The cultural method has the advantage that it is technically simple, cheap, and reliable. It does not, however, demonstrate the pathogenicity of the organism. Occasionally contamination with molds occurs in cultures. We believe that in every case of renal tuberculosis all of the methods should be employed. They serve to check each other and in that way error and delay in the establishment of diagnosis are obviated, or, at least, reduced to a minimum.

Nearly 75 per cent of the earliest renal lesions are in the cortex. Subcortical lesions remain closed lesions until extension into the pyramid occurs. However, when ulceration takes place tubercle bacilli are liberated in the urine and an "open lesion" results. Should the lesion be located at the tip of a renal papilla, its ulceration into a calyx may at once set free tubercle bacilli, pus and blood. One may readily understand the difficulty in establishing an early diagnosis of renal tuberculosis in cases in which the unilateral or bilateral nature of the lesion is in question. Then too, according to recent views, a renal tuberculosis which was unilateral in the beginning may become bilateral at a later date.

In accord with the modern idea of the majority concerning the genesis of uni-

lateral renal tuberculosis, bacilli reach both kidneys even though the process is progressive on one side and retrogressive on the other. In the latter case there may exist a special factor which inhibits the infecting organism from gaining a foothold. Just what the determining factor in the genesis of unilateral renal tuberculosis is, requires further clinical and pathologic research. It is maintained that some degree of mechanical obstruction to the outflow of urine may exist which renders it difficult or impossible to demonstrate clinically.

One may safely state that the instances of bilateral renal involvement will increase in direct proportion to the thoroughness and accuracy of diagnosis. It is to be remembered that one should not overlook the possibility of a bilateral infection and perhaps subject the patient to an unnecessary surgical procedure. The opposite condition may exist, in which a diagnosis of bilateral renal tuberculosis has been made by error. Such a diagnosis may lead to deprivation of surgery when the only therapeutic agent is nephrectomy.

All recent writers on renal tuberculosis mention the fact that co-existence of renal and genital tuberculosis can be demonstrated to a greater extent than heretofore. One may readily understand that if renal or genital tuberculosis is a local manifestation of a generalized infection and follow most frequently pulmonary tuberculosis, the possibility of distribution of the tubercle bacilli to any part of the urogenital tract is always present. The possibility of infection by interchange from the urinary tract to the genital tract is readily recognized. Many patients presenting themselves with renal tuberculosis are free from genital involvement. Early appearance of tuberculosis in the epididymus is usually the reason for the patient's appearance in a physician's office, whereas early renal tuberculosis may not be brought to his attention until definite bladder symptoms are noted. In a recent study of the surgical records of renal tuberculosis (67 nephrectomies, 1928 to 1933), genital

involvement was noted in 34 per cent of the cases some time before or after the nephrectomy. This incidence of renal and genital tuberculosis is possibly higher than numerous writers state.

It is important to have information at hand relative to the pulmonary condition of the patient. Our routine is to have a roentgen-ray of the chest in addition to the physical examination. Many patients do not know that they have pulmonary tuberculosis, or if they are cognizant of it, they say nothing about it because the urinary symptoms predominate in the picture. The necessity of a thorough history may seem irrelevant, but it is amazing to note the dearth of clinical data in surgical records. This alone may account for the divergence of opinion as to the frequency of renal tuberculosis.

Adult tuberculosis is usually a chronic disease and the most acute symptomatology is often present in the urinary tract. The very nature of the disease in the kidney, as well as the intermittent activity of the ureteral and bladder lesions, leads to periods of remission in the signs and symptoms. This may give a false sense of security and cause difficulty in establishing a diagnosis. Patients without a previous urinary history are sometimes examined, and renal destruction, with active tuberculous infection, may be found. Predominance of urinary symptoms and the degree of their severity depend largely upon the amount of infection of the bladder. The urologist will often state that when early surgical treatment is instituted the function of the bladder is less impaired.

In a study of a series of cases of urogenital tuberculosis, marked involvement of the bladder was reported. The question was raised since the majority of writers have mentioned the fact that bladder infection has been greatly reduced. This may be true. However, in our clinic we very frequently note the typical contracted, irritable tuberculous bladder. The ulcerative golf-hole meatus is becoming more rare. In more than half of the bladders examined, there existed about

one or the other ureteral meatus changes which led the cystoscopist to believe he was dealing with a case of renal tuberculosis.

We employ ureteral catheterization in every case of suspected renal tuberculosis. Specimens of urine are collected for direct examination, culture, and inoculation of guinea pigs. There is always a question of debate whether the apparently normal kidney should be catheterized when the other one is tuberculous. I believe that infecting a sound kidney in such a case depends to a great extent on the skill of the operator. It has been the practice in our clinic to refrain from catheterization of a kidney if we are dealing with a non-functioning tuberculous organ on one side when the opposite meatus is normal and the indigo carmine excretion on that side indicates good function. If both kidneys present a fair or good functional dye test we do not hesitate to investigate them for evidence of bilateral involvement. Excretion urography is not sufficiently positive to make this distinction for us, as some urologists believe. The possibility of carrying tubercle bacilli to the opposite kidney through a reflux from the bladder is slight if cystoscopic and ureteral catheterization are properly done.

The use of indigo carmine intravenously as a functional dye test has not in our experience added much to the diagnosis. Braasch (12) has repeatedly emphasized the doubtful value of functional tests in renal tuberculosis. The recent observations of Lieberthal and Huth (10) in a series of cases of early renal tuberculosis indicate a diminution of renal function on the affected side in every case. Cryoscopy was employed as the method of choice for determining the function.

In employing urography in the diagnosis of renal tuberculosis, one should always follow the fundamental principle that it is unnecessary if a diagnosis can be made without it (Braasch, 12). In many instances in which the bladder and the ureteral orifices show no definite evidence of disease, nor suggestion of it, and the cul-

tures and smears give negative results, uretero-pyelography is the only means of identifying the lesion present. Pyelograms are indispensable in the diagnosis of early lesions.

Many urologists have the roentgenologist make simultaneous bilateral pyelograms. We do not do this at Jefferson, although every pyelogram made is done under fluoroscopic control. It is the exception rather than the rule to inject the renal pelvis by a syringe. We use the gravity method of allowing the sodium iodide solution to run into the renal pelvis, gauging the flow by the instruction of the roentgenologist. It is believed that this method tends to cause less irritation to the patient.

The early pyelographic filling defect found with renal tuberculosis is produced by a small area of renal destruction—a cortical abscess—usually found at the tip of a calyx. As the destruction becomes more marked, the filling defect is more noticeable and the typical feathery, fuzzy shadow of the calyx appears.

Excretion urography often fails to outline pelvic deformities. In early renal tuberculosis, the substances in use to-day do not delineate the minor deformities of calyx and pelvis. In cases in which there is some ureteral obstruction, as is often the case in tuberculous ureteritis, enough of the solution may remain in the kidney pelvis and bring out the pelvic deformity. It is only in advanced cases in which destruction and pyelectasis are marked that the specific deformity is recognizable. In cases in which cystoscopy and ureteral catheterization are not possible, excretion urography is valuable, and may aid in establishing a diagnosis of renal tuberculosis. The interpretation of urograms should be made with great care and correlated in each instance with clinical findings. Retrograde pyelography still maintains its place as the more accurate method of roentgenologic diagnosis.

It is well to bear in mind that tuberculosis of the kidney may be co-existent with other renal lesions. Recently there was

presented before a group of urologists a kidney showing an active tuberculosis with a carcinoma. Calculous disease may also be present, first, as a result of a calcification of the tuberculous process or as an independent lesion. A case referred to one of us revealed a calcareous density in the renal pelvis situated at the uretero-pelvic junction. The clinical picture and symptoms were suggestive of urinary tuberculosis. A radiograph of the chest was reported by the roentgenologist as showing an acute respiratory infection. There was no evidence of lung tuberculosis. A retrograde pyelogram was suggestive of tuberculosis. The excretion urograms were misleading in view of our retrograde studies. Tubercle bacilli were recovered in culture and from an inoculated guinea pig.

The question of the diagnosis of renal tuberculosis resolves itself into a composite picture in which the internist, pathologist, roentgenologist, and urologist should hold sway. A closer contact with the internist, who sees many cases of general tuberculosis, cannot but impress the general medical profession that every patient with pulmonary tuberculosis is a candidate for renal tuberculosis. The necessity is evident, therefore, of instituting a complete urologic study in the presence of the earliest urinary symptoms.

Thus, the management of renal tuberculosis must be based upon the fact that it is an expression of a general infection. The best assurance of a permanent cure will result only if this thought is applied to our routine work.

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A SPECTROGRAPHIC METHOD OF MEASURING VOLTAGE WAVE FORM OF A ROENTGEN TUBE¹

By R. R. NEWELL, M.D., *San Francisco, Calif*

From Stanford University School of Medicine

BECAUSE x-ray tubes are often run on alternating or pulsating current, the wave form both as to current and potential is important. Both affect the roentgen efficiency of the tube and the quality of the ray.

Dr. Chamberlain and I (1) studied this by a stroboscopic method, using hardness of the beam as a measure of momentary tube voltage. Later, we worked with a

of the focal spot, and of course no focal spot is evenly bright all over. But such a spectrum is still useful for measurement of the short wave limit (2). It is true that photographic spectrography for short wave limit is not a very precise method at the higher voltages where λ_{min} is short and angles of reflection correspondingly small. But it is good enough for a rough evaluation. If such a spectrum is recorded

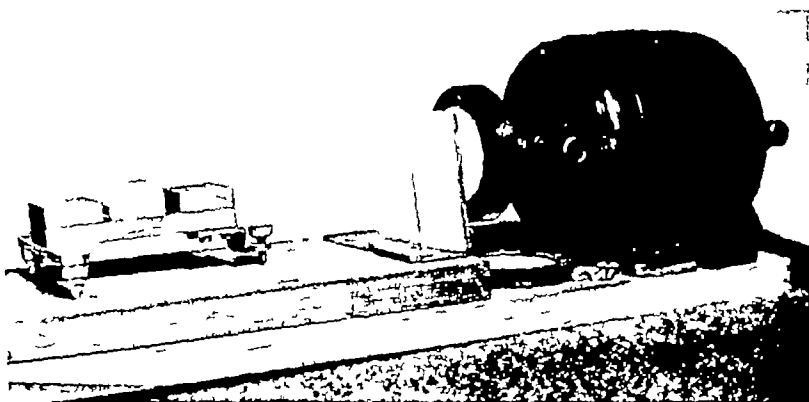


Fig. 1. Spectrograph slit and synchronously rotated double screen cassette for strobospectrography. These have been removed from their lead lined box with the cover of the cassette off; the face of the lead plate has been whitened to show the slit.

cathode-ray oscillograph. I thought it might be interesting to try a spectrographic method.

If the first slit of an x-ray spectrograph is wide enough to take in the whole focal spot and the second slit consists of a wedge against the face of the crystal (Seemann slit) then the spectrograph will cover a considerable range of wave lengths with crystal stationary. Such a spectrum is of little value for studying the energy distribution in the spectrum because each portion originates in its own separate portion

through a radial slit onto a film rotating in synchronism with the voltage wave applied to the x-ray tube, then the minimum wave length will be recorded in polar coordinates for the whole cycle and one will have a record of the voltage wave form at the target.

The advantages of the method are its simplicity and the fact that the voltage measured is that of the electrodes within the x-ray tube and not some other place in the high tension circuit. Figures 1 and 2 are a photograph and a diagram of the roentgen strobospectrograph. Figure 3 exaggerates the vertical scale to make clear

¹ Read before the Fourth International Congress of Radiology, at Zürich, July 27, 1934.

what can be expected in the way of "resolution" from such a spectrograph. With a good calcite crystal the sharpness of the spectrum is very satisfactory. We have

cially when using intensifying screens. This last pair of difficulties does much more to render the absolute values of voltage dependable than does the imperfection

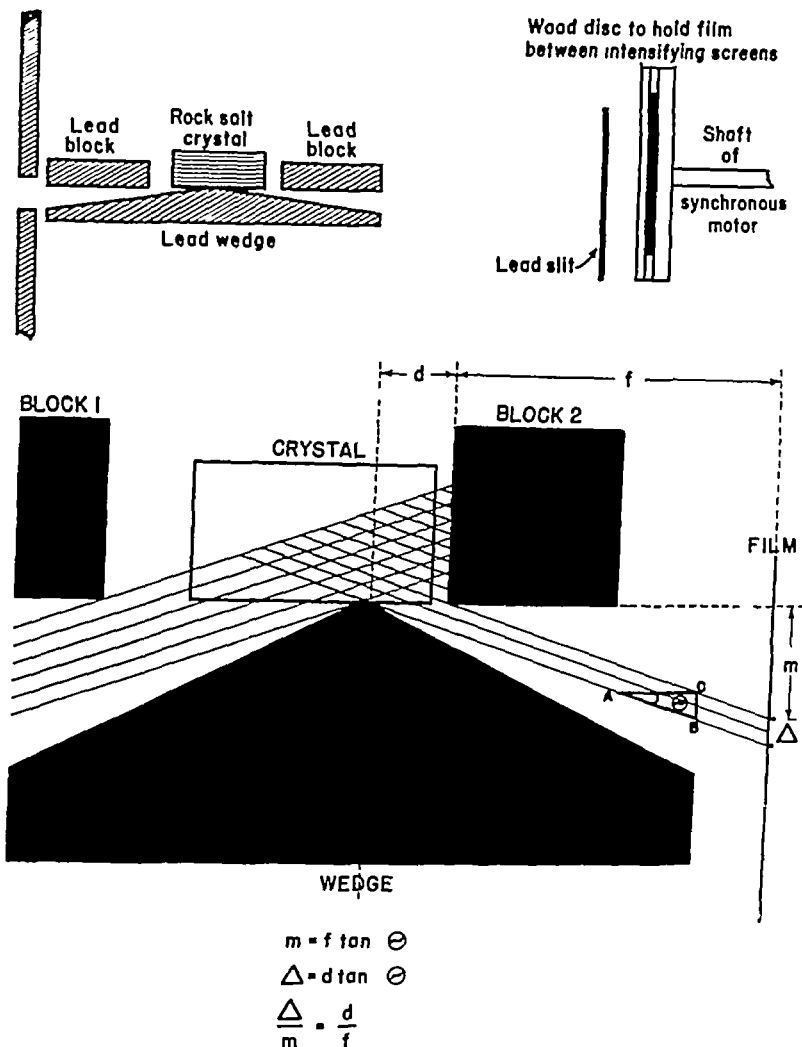


Fig 2 Diagram of strobospectrograph

Fig 3 Resolving power of the spectrograph depends on the ratio of effective slit width to deflection. For any given wave length the deflection m is the film distance f multiplied by the tangent of the glancing angle of reflection. The small triangle ABC set in the reflected beam makes it easy to see that the effective slit width Δ is similarly equal to the actual horizontal slit width, d multiplied by the tangent of the glancing angle of reflection. Therefore the resolving power depends only on the ratio of horizontal slit width to film distance and is constant throughout the range of wave lengths.

usually preferred rocksalt, however, because its lack of perfection increases its speed, sometimes to one hundred times that of calcite. It requires a very heavy exposure to bring out the short wave limit and then one begins to get halation, espe-

of the crystal. However, the relative values, *i.e.*, the general shape of the voltage wave, is more dependably shown.

There is one pitfall that must be carefully avoided, namely, too small a focal spot to cover the entire voltage range

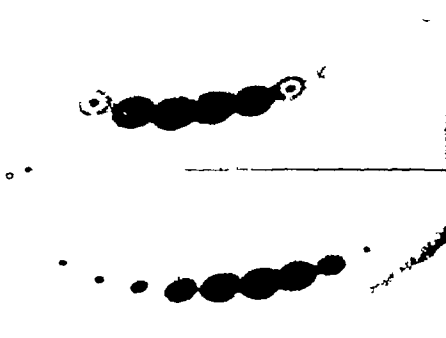


Fig 4

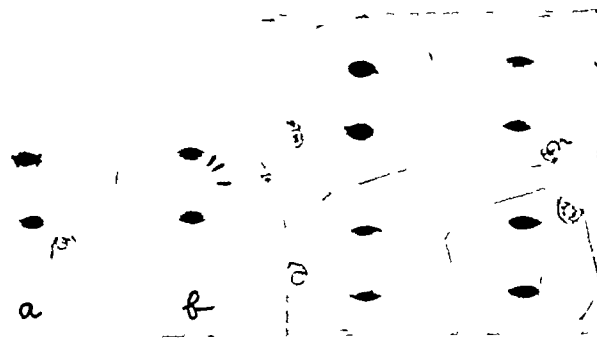


Fig 5

Fig 6

Fig 4 Focal spots taken one-twenty fourth cycle apart. This was a thick-walled air-cooled tube i.e., the target cooled itself by radiation at white heat. Both records were made at 200 K V peak, 5 ma, the lower one when tube was first turned on the upper one after 20 minutes operation when the glass had become heated. The output when hot was 85 per cent of what it was when cold.

Fig 5 Strobospectrograms from thick walled tube (a), tube cold (b) tube hot. No change in setting between runs. Exposures 5 min, 200 K V peak, valve rectified 5 milliamperes. The elongated black spots are spectra taken with the film standing still. They show the width of the radial lead slit. Their uneven spacing was used to record the direction of rotation of the film.

Fig 6 Misleading strobospectrograms due to inadequate size of focal spot. These four records were all made at same settings but with differing levelings of the spectroscope before the tube.

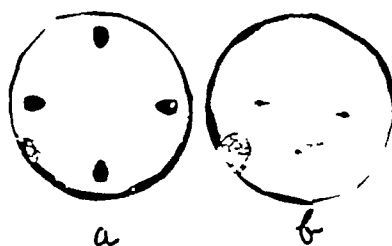


Fig 7 Examples of strobospectrograms (a) disc rectified at 130 K V short high tension leads (b) four arm (Snook) rectified at 100 K V long high tension leads. In the original film one can make out a triple voltage peak.

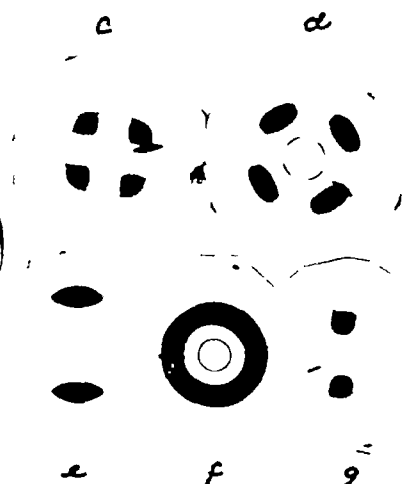


Fig 8 Examples of strobospectrograms (c) four arm (Snook) rectified at 200 K V (d) disc rectified at 200 K V (e) valve rectified at 200 K V (f) constant potential at 200 K V (g) Sloan tube at about 700 K V

One may have to move the instrument relative to the tube during the exposure, so that a small focal spot may cover a wide range. One cannot depend on the focal spots being the same size throughout the cycle. Figure 4 shows the variation of size of focal spot in a tube of thick glass, first cold and then after warming the glass by twenty minutes' operation with target incandescent. Figure 5 shows the mis-

leading "tail" on the strobospectrogram during the times when the focal spot is very small. This disappears when the tube warms up. Figure 6 shows how the position of this tail changes for differing levelings of the spectrograph before the tube.

Some examples of strobospectrograms are shown in Figures 7 and 8—the captions explain them. Only one needs further com-

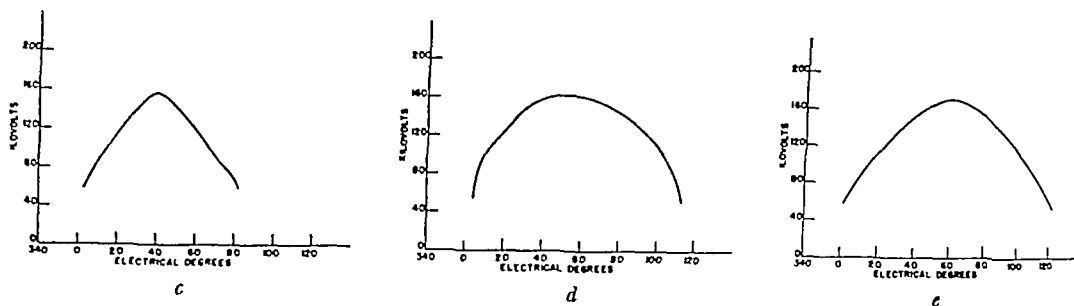


Fig 9 Three strobospectrograms (*c*, *d*, and *e* of Fig 8) reduced to voltage in rectangular co-ordinates. Obviously one eye has stopped short of the short wave limit for the curves go only to about 170 K V although sphere gap readings in each instance gave 200 K V. This 15 per cent error is presumably not to be taken at full value in interpreting the records for *wave form*, however.

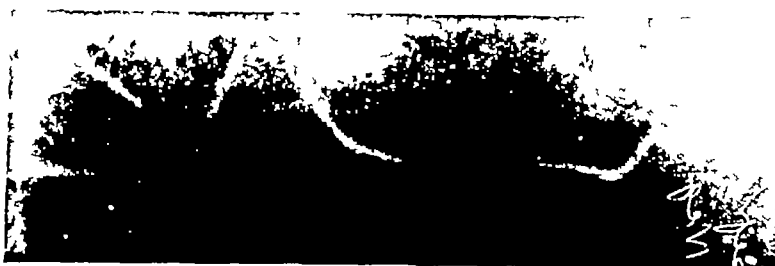


Fig 10 A cathode ray oscillogram made at an earlier date on the same outfit giving strobospectrogram *e*. Note how much of interest in the lower voltages (below 50 K V) the strobospectrogram misses because of inadequate intensity.

ment, namely, the Sloan tube at University of California Hospital. This is a self-rectified Tesla Oscillator enclosed in the x-ray tube itself and operated at six megacycles. The individual waves, being only a six hundredth of a degree apart, are not seen separately. The wave actually seen, then, is the envelope of the six megacycle waves which are developed only during the peaks of the 60-cycle supply current. In all the others each sector element of the record is a constant potential sample of the alternating voltage wave.

SUMMARY

The author shows how a spectrograph with Seemann slit can be used with a synchronously rotating film to analyze the voltage wave form on a roentgen tube.

He shows examples of such strobospectrograms.

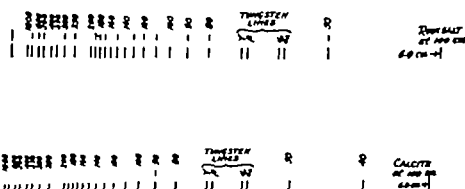


Fig 11 Scales for measuring strobospectrograms made at 100 cm (or at 20 cm and enlarged $\times 5$).

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CERTAIN DIAGNOSTIC PHASES OF EXCRETION UROGRAPHY¹

By ALFRED E JONES, M D, and ROBERT A ARENS, M D,

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Chicago

SINCE Von Lichtenberg and Swick, in 1929, made intravenous urography a practical procedure, this method is proving of more and more value in the diagnosis of urinary tract pathology. At first it was thought that this procedure would be of use chiefly in those cases in which cystoscopy and retrograde urography were difficult or impossible. However, as time went on, the utilization of this method not only by the urologist but by the internist, etc., as well, proved of incalculable value in picking up both urinary tract and contiguous pathology, such as perinephritic abscess and retroperitoneal tumors. At the Michael Reese Hospital, in Chicago, where the work for this paper was carried out, the use of intravenous urography as a routine procedure is urged upon the internists, general surgeons, and gynecologists in any and all cases in which the diagnosis is in the least obscure. As a result, the amount of work



Fig 1, Case 1



Fig 2, Case 2

on the genito-urinary service has more than doubled in the past four years, while the number of cystoscopies with retrograde urograms has decreased about 40 per cent.

Since our contribution is only part of a general symposium on Intravenous Urography, no attempt will be made to cover all of its phases, but we will confine ourselves to three main points, as follows: (1) The superiority of intravenous urography over retrograde urography in cer-

¹ Read before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis Tenn. Dec 3-7, 1934.

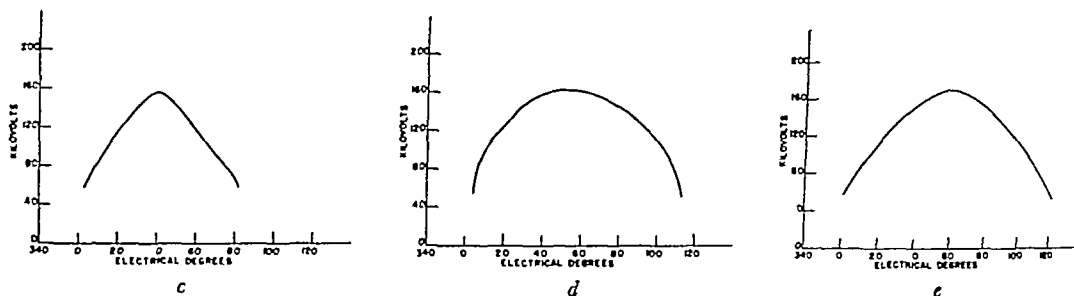


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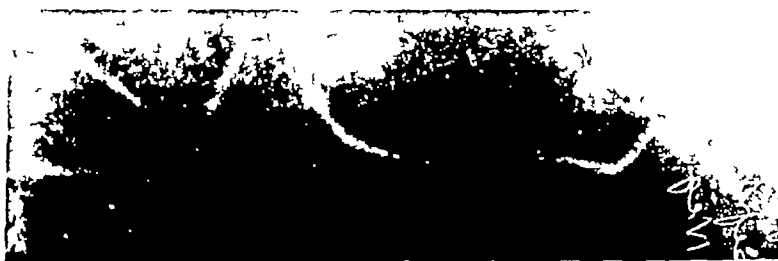


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Fig 7, Case 7



Fig 8, Case 8



Fig 9, Case 9

Fig 10, Case 10

the passage of a shadowgraph catheter into the right ureter, with perhaps a right-sided pyelogram. However, a normal intravenous urogram ruled out the possibility of kidney or ureteral pathology and at operation a retrocecal inflamed appendix was removed.

Case 2. A man of 25 entered the hospital with right lower quadrant pain,

vomiting, temperature of 100° F, and leukocyte count of 12,000. He had exquisite tenderness along the course of the right ureter and the urine showed microscopic blood and pus. An intravenous urogram revealed a small but very definite shadow in the lower right ureter, with dilatation above the shadow. Narcotics were administered for the pain, and the



Fig 3 Case 3



Fig 4 Case 4



Fig 5 Case 5



Fig 6 Case 6

tain well-defined cases, (2) the use of intravenous urography in the differential diagnosis of intraperitoneal and retroperitoneal tumors, and (3) the value of intravenous urography in the diagnosis of ureteral stones, especially those of the radiotranslucent variety accompanied by unilateral anuria

1 THE SUPERIORITY OF INTRAVENOUS UROGRAPHY OVER RETROGRADE UROGRAPHY IN CERTAIN WELL DEFINED CASES

Case 1 The first case is that of a

normal intravenous urogram There would be nothing unusual in this, were it not for the fact that this young man entered the hospital with all of the symptoms of acute appendicitis In the routine study of the case, a moderate number of red cells were found in the microscopic urinalysis, some twenty to thirty to the high-powered field A scout film of the urinary tract disclosed several questionable shadows, any one of which might possibly be a right ureteral calculus Formerly, this patient would have been subjected to a cystoscopy and



Fig 7 Case 7



Fig 8, Case 8



Fig 9, Case 9

Fig 10 Case 10

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Fig 11 Case 11

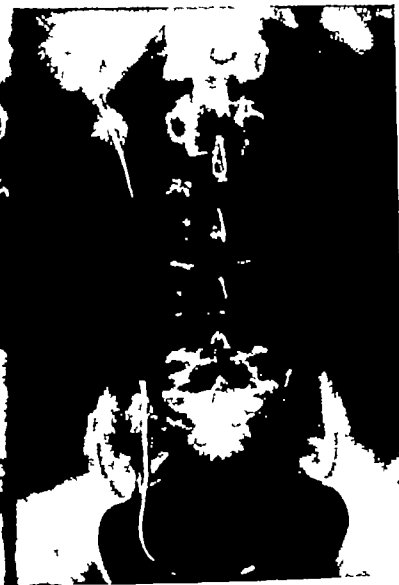


Fig 12 Case 12



Fig 13, Case 13



Fig 14 Case 14

next day the patient passed a stone, with complete cessation of his symptoms

Case 3 The symptoms in this case were all left-sided, and a shadow on the scout film, coupled with the urinary findings of blood and pus, justified a diagnosis of left ureteral stone. However, an intravenous urogram verified this and obviated the necessity of cystoscopy and retrograde urography. As the shadow was of small size and located in the intramural part of

the ureter, no manipulation was attempted. After the pain subsided, the patient was allowed to go home. He returned to the out-patient department five days later and produced the stone.

These three cases are more or less typical of many others in which the patients were saved the pain and discomfort, to say nothing of the danger of infection, reaction, etc., of a retrograde urogram. However, it would have been perfectly possible to



Fig 15 Case 15

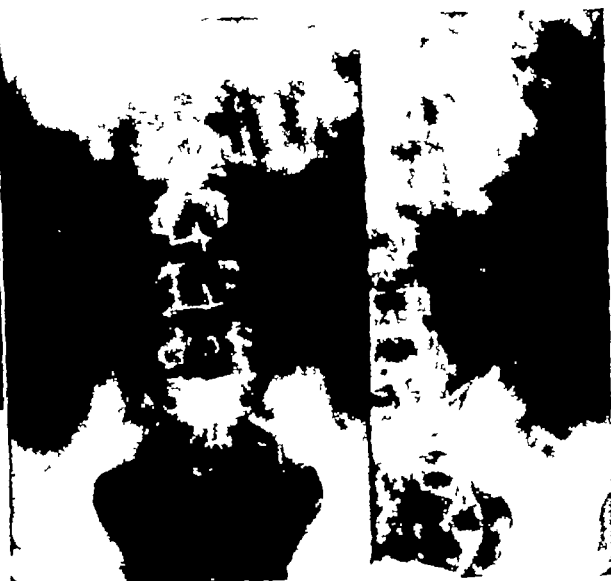


Fig 16 Case 16

carry out retrograde urography in the above cases, with perhaps equally good results as far as the diagnosis is concerned.

In the next three cases, in which an anomalous condition exists, namely, that of double ureter, the superiority of intravenous urography over the retrograde type cannot be questioned.

Case 4 A girl, 9 years of age, had had pain in the left upper quadrant of the abdomen and the back for the past six years. Her parents had consulted several leading pediatricians concerning the cause of this pain, but no definite diagnosis was ever arrived at. An intravenous urogram taken as a routine in just such obscure cases, disclosed an anomalous condition of the left upper urinary tract which could very well account for the pain.

Case 5 A male child six months of age had been treated for pyelitis for the past four months. However, when he began to have daily chills and fever, and the pus in the urine increased, he was taken to the hospital. An intravenous urogram using one-half the adult dose, as children tolerate this drug very well, disclosed an enormous destruction of the parenchyma of the right kidney, while the left side was perfectly normal. The right kidney, with a double ureter, was removed and the child made

an uneventful recovery, the wound (only four inches long) healing in six days. The value of intravenous urography in this case cannot be overestimated by those who appreciate the difficulty of cystoscopy and catheterizing the ureters of a six-months-old male infant.

Case 6 A man, 34 years old, had had pain, burning, and frequency of urination for the past six months. The venereal history was negative and there was no urethral discharge, but the urine contained both blood and pus in moderate amounts. In the early weeks of his ailment he had developed some discomfort in the left loin, and so he had consulted a urologist, who cystoscoped him and catheterized the ureters. He was told that he had a stricture of the left ureter, which should be treated by successive dilatations. Since the patient knew by experience that this was a painful procedure, he very naturally balked and asked for consultation, to ascertain if anything other than this could be done. An intravenous urogram disclosed a double ureter on the left side, the proximal end of one ureter ending in a blind sac. At operation, this ureter, ending in a blind sac, was resected, with complete cessation of all symptoms.

Case 7 One more case will serve fur-



Fig 11 Case 11



Fig 12 Case 12



Fig 13 Case 13



Fig 14 Case 14

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Case 3 The symptoms in this case were all left-sided, and a shadow on the scout film, coupled with the urinary findings of blood and pus, justified a diagnosis of left ureteral stone. However, an intravenous urogram verified this and obviated the necessity of cystoscopy and retrograde urography. As the shadow was of small size and located in the intramural part of

the ureter, no manipulation was attempted. After the pain subsided, the patient was allowed to go home. He returned to the out-patient department five days later and produced the stone.

These three cases are more or less typical of many others in which the patients were saved the pain and discomfort, to say nothing of the danger of infection, reaction, etc., of a retrograde urogram. However, it would have been perfectly possible to



Fig 15 Case 15

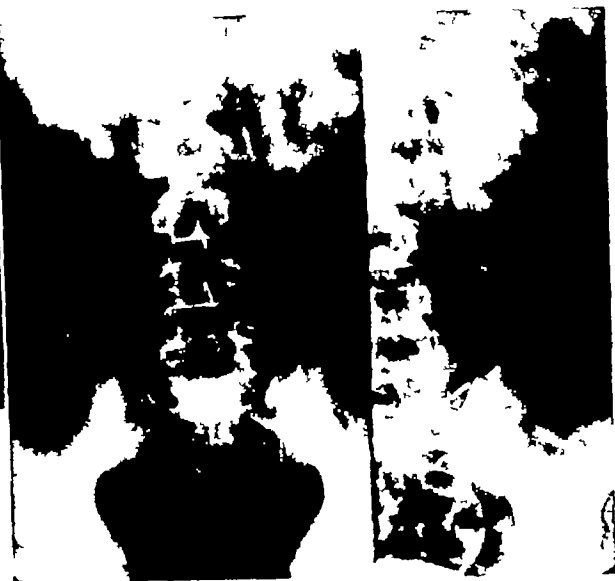


Fig 16, Case 16

carry out retrograde urography in the above cases, with perhaps equally good results as far as the diagnosis is concerned.

In the next three cases, in which an anomalous condition exists, namely, that of double ureter, the superiority of intravenous urography over the retrograde type cannot be questioned.

Case 4 A girl, 9 years of age, had had pain in the left upper quadrant of the abdomen and the back for the past six years. Her parents had consulted several leading pediatricians concerning the cause of this pain, but no definite diagnosis was ever arrived at. An intravenous urogram taken as a routine in just such obscure cases, disclosed an anomalous condition of the left upper urinary tract which could very well account for the pain.

Case 5 A male child six months of age had been treated for pyelitis for the past four months. However, when he began to have daily chills and fever, and the pus in the urine increased, he was taken to the hospital. An intravenous urogram using one-half the adult dose, as children tolerate this drug very well, disclosed an enormous destruction of the parenchyma of the right kidney, while the left side was perfectly normal. The right kidney with a double ureter, was removed, and the child made

an uneventful recovery, the wound (only four inches long) healing in six days. The value of intravenous urography in this case cannot be overestimated by those who appreciate the difficulty of cystoscopy and catheterizing the ureters of a six-months-old male infant.

Case 6 A man, 34 years old, had had pain, burning, and frequency of urination for the past six months. The venereal history was negative and there was no urethral discharge, but the urine contained both blood and pus in moderate amounts. In the early weeks of his ailment he had developed some discomfort in the left loin, and so he had consulted a urologist, who cystoscoped him and catheterized the ureters. He was told that he had a stricture of the left ureter, which should be treated by successive dilatations. Since the patient knew by experience that this was a painful procedure, he very naturally balked and asked for consultation, to ascertain if anything other than this could be done. An intravenous urogram disclosed a double ureter on the left side, the proximal end of one ureter ending in a blind sac. At operation, this ureter, ending in a blind sac, was resected, with complete cessation of all symptoms.

Case 7 One more case will serve fur-

ther to emphasize the first point which we wish to bring out, namely, in certain cases, the superiority of the intravenous route

2 THE USE OF INTRAVENOUS UROGRAPHY IN THE DIFFERENTIAL DIAGNOSIS OF INTRA-PERITONEAL AND RETROPERITONEAL TUMORS

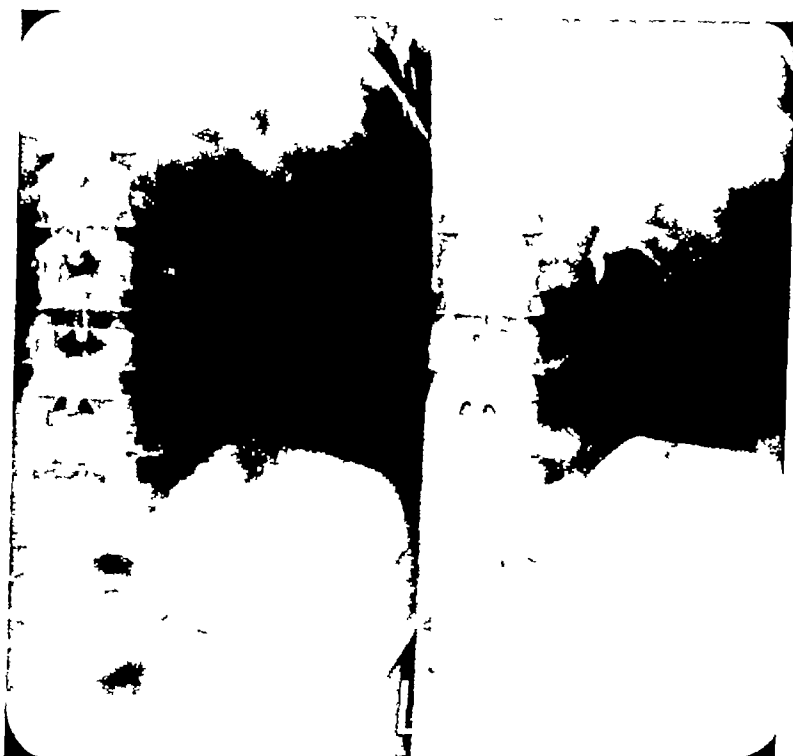


Fig 17, Case 17

A woman seven months pregnant entered the hospital with all the symptoms of impending uremia. The tongue was furred, the skin was dry, the urine scanty and concentrated, and vomiting and twitchings were in evidence. The blood chemistry disclosed a non-protein nitrogen of 216, with a creatinin of 8, while a scout film of the urinary tract showed a shadow apparently in the course of the right ureter. Realizing the difficulties and danger of the retrograde method in this case, an intravenous injection of dye was administered and the subsequent reontgenograms verified our suspicions of a right ureteral stone (Fig 7). This stone was removed through a ureterotomy incision and the patient made a good recovery, went on to term, and was delivered of a normal infant.

Before the advent of intravenous urography, there were two known methods of differentiating intraperitoneal from retroperitoneal tumors, pre-operatively. One was by inflating the colon with air or contrast medium, to determine if the mass was in front of or behind the colon. This method was far from satisfactory, as there were several cases of tumor behind the colon and still intraperitoneal. The other method was by cystoscopy and retrograde ureteropyelogram. An intravenous urogram will accomplish the same result, as the following cases so clearly demonstrate. The retroperitoneal space is so small, normally, that it is practically impossible for a tumor of any appreciable size to exist in this locality without producing definite changes in the size, shape, or position of the ureter, pelvis or kidneys. Therefore,

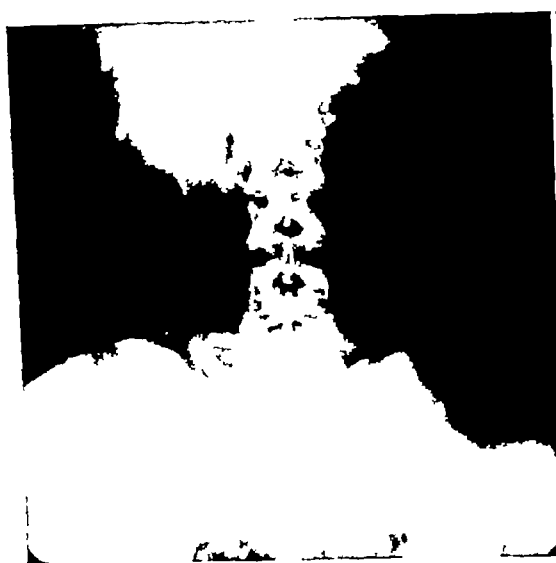


Fig 18, Case 18



Fig 19 Case 18

a normal intravenous urogram is strong evidence against the presence of a retroperitoneal tumor

Case 8 The patient was a woman, 32 years old and seven months pregnant, with a mass in the lower left quadrant of the abdomen, of the existence of which she was unaware until examination in the prenatal clinic. This mass was about the size of an orange, smooth, firm, not tender to the touch, and slightly movable. The vaginal examination of the left adnexa was unsatisfactory, due to the size of the gravid uterus. An intravenous urogram showed dilated ureters and pelves, but entirely within normal limits for a seven-months pregnancy. The right ureter was dilated more than the left, which is also a common finding in pregnancy after the fifth month. If the mass in the left side were retroperitoneal, it would be reasonable to expect to find the left ureter dilated more than the right. The patient was allowed to go on to term, and several weeks later a vaginal examination disclosed an intraligamentous cyst, which was removed by operation.

Case 9 A man, 75 years old, consulted his family physician because of obstinate constipation. During the course of the physical examination the physician felt a

mass in the left abdomen, and sent the man in on the general surgical service for a complete study. The urinalysis was normal and the gastro-intestinal examination was entirely negative. A scout film of the genito-urinary tract showed a circular shadow on the left side, but it was not very clear. However, the first film after the intravenous injection of contrast medium showed this mass in a much clearer light, and the subsequent films disclosed a marked increase in the pictorial density of this shadow. Since practically all of the medium is excreted by the kidneys, that mass must be either the kidney or a part of the kidney. There is no other way in which the contrast medium could get into the mass. On account of its globular appearance, etc., a diagnosis of a large cyst of the kidney was made. This diagnosis was confirmed at operation, when we were able to resect the cyst and save the kidney, which was otherwise perfectly normal.

Case 10 H B, a male, 22 years of age, had an enormous mass which practically filled the entire right abdomen and extended even beyond the midline over to the left side. It was firm, but not hard in consistency, immovable, somewhat nodular, and not at all tender to touch. A shadowgraph catheter passed up on the

right side showed the ureter to be pulled over to the left beyond the midline, and a pyelogram disclosed a displaced and distorted pelvis on the right. An intravenous urogram not only confirmed these findings, but, in addition, showed a normal left upper urinary tract. This latter finding proved to be very valuable. At operation, an enormous lipoma, weighing 26 pounds, was removed from the right retroperitoneal space. The tumor was so intimately attached to the right kidney that it was impossible to dissect it free, and the kidney also had to be sacrificed.

Before discussing the final point in this presentation, namely, that of the use of intravenous urography in the diagnosis of ureteral stones, we wish to present a series of five cases demonstrating the superiority of intravenous urography over the retrograde type.

Case 11. Congenital solitary tuberculous kidney in a boy 18 years of age, in which case cystoscopy was impossible due to a contracted, inflamed bladder.

Case 12. Congenital solitary kidney in a man 42 years old, with a stone blocking the only ureter. A catheter was passed up beyond the stone, but intravenous urography disclosed the absence of the left kidney. The stone was subsequently passed.

Case 13. A right tuberculous pyonephrosis, shown very clearly by intravenous urogram, in which it was impossible to get up either catheter or contrast fluid by cystoscopy.

Case 14. A right tuberculous kidney in which the findings on retrograde urography were confirmed by intravenous urography, and, in addition, the opposite side was shown to be normal.

Case 15. A horse-shoe kidney, picked up by employment of intravenous urography as a routine procedure, in a case in which the diagnosis of the abdominal ailment was obscure.

3 THE VALUE OF INTRAVENOUS UROGRAPHY IN THE DIAGNOSIS OF URETERAL STONES, ESPECIALLY THOSE OF THE RADIO-

LUCENT VARIETY, ACCOMPANIED BY UNILATERAL ANURIA

Our last series of cases concerns the diagnosis of ureteral stones by the employment of intravenous urography. In cases in which there is a complete block of the ureter, the affected side invariably fails to secrete the contrast medium, and this in itself is a tremendous help in the diagnosis of ureteral stones, especially those of the radiolucent variety. As soon as the stone is passed, the kidney immediately begins to secrete. This was very beautifully demonstrated in the first case in this group, of which a résumé follows.

Case 16. Unilateral calculus anuria. Stone passed into bladder while the patient was on the x-ray table. The fifteen-minute film shows the kidney pelvis and the calices to be completely filled out.

Case 17. Stone blocking left ureter and producing unilateral anuria. Normal excretion after stone was removed by ureterotomy.

Case 18. Lack of excretion on the left side, in a young girl who had symptoms of backache and slight hematuria. No stone shadow visible. Bringing into use our previous experience in these cases, we cautioned against operation and advised delay. In two weeks' time a small stone was passed and subsequent films showed a normal left intravenous urogram.

SUMMARY

Intravenous urography should not be used by the urologist only, but should be employed as a routine measure in all cases in which the diagnosis is obscure.

In at least 50 per cent of the cases, cystoscopy and retrograde urography can be avoided.

It is by far the best method in differentiating intraperitoneal and retroperitoneal tumors.

Its value in the diagnosis of ureteral stones, especially those of the radiolucent variety, cannot be questioned.

MULTIPLE UROGRAMS. AN AID IN UROLOGICAL DIAGNOSIS

By EDGAR C BAKER, M D , and JOHN S LEWIS, JR , M D , *Youngstown, Ohio*

WITH the growth of work in urographic diagnosis many shortcomings in our methods have become increasingly noticeable. Our roentgen and other medical journals contain innumerable articles which deal with pathologic function in the other tracts of the body, notably the gastro-intestinal tract. From the roentgenologic aspect, there is a marked paucity of work dealing with pathologic function of the urinary tract. The work published along this line is largely of an experimental nature and carries little significance to those of us doing routine work in a situation in which experimental work is almost out of the question. It has seemed to the writers that, in urology, we, as roentgenologists, were content to drift easily along the lines of least resistance. In other fields we have dared to create, and actually have created, an ever-growing field of usefulness. A great amount of our information in medicine has come through our study and interpretation of the pathologic function. In this field roentgenologic methods offer a pre-eminent advantage. True, we have accepted the intravenous dyes and the wonderful advances made possible by the endoscopic methods of our urologic colleagues. In return, most of the time we have offered them very little but technical aids, which have changed but little, and these only as newer roentgen methods have compelled advance.

In 1922, Nichols (1) wrote that urographic diagnosis must be team-work, a statement which is even more true to-day. It is only when roentgenologists realize that they owe a real part to team effort, and act accordingly, that we will make greater advances. Where such team-work is in force, the urologist realizes the benefit to the patient and he abandons single-handed effort. The method of urographic diagnosis which will be described is based on adequate co operation. The result is

dependent on the closeness of mutual effort by urologist and roentgenologist.

While we realize the results we attain are far from the experimental efforts of Jarre and Cumming (2, 3, and 4), we also believe our results justify the technic employed. In addition, the method can be carried out routinely in any average roentgen department. From a diagnostic viewpoint, the method has added an increasing number of conditions recognizable roentgenologically and has been a distinct help in the finding of changes which occur in common urographic conditions. We have a sincere admiration for the well-known work of Jarre and Cumming. Unfortunately the expense of their method precludes its use for almost all of us. Methods can and will be devised which approximate their results for routine clinical purposes.

The method of Moore (5 and 6) brings the use of serial roentgenographic films into the realm of practical urology. This procedure can be adapted for routine work in most roentgen departments. This serial film, combined with pyeloscopy, we use for selected cases.

The history of the development of urographic diagnosis belongs more properly to a purely urologic paper. Opaque bougies were first employed. With the advent of the intravenous dyes an almost ideal medium came into use. On the roentgen side a few high lights should be mentioned. In 1918, after six years' experience, Manges (7) advocated the use of pyeloscopy. The continued development of the Bucky diaphragm has aided greatly. With increasing power and better tubes, speed in exposure time without the sacrifice of detail has become increasingly possible.

TECHNIC EMPLOYED

While we do not claim to present anything radically new, we do expect to pre-

sent a co-operative effort utilizing known procedures in a little-appreciated sequence

Usually an ordinary film of the entire urinary tract is taken prior to cystoscopy. The usual cystoscopic examination is made. Inspection of the bladder—the posterior urethra in the male and the entire urethra in the female—is completed. Indigo carmine is injected intravenously and the time of appearance of a concentrated dye is noted. Catheters are passed into the kidney pelves, non-obstructing catheters being used whenever possible. Specimens are collected under aseptic precautions for laboratory examination. The cystoscope is removed and the catheters left in place, after which second specimens for laboratory examination are collected. The patient is now transferred to a roentgenologic table with the usual fluoroscopic and Bucky equipment.

If a film has not been taken prior to cystoscopy, this is now done. In cases showing a suspicious shadow or shadows in the region of the ureter a shift exposure is made. The catheters are now connected by means of metal adapters to syringes containing a known amount of 15 or 20 per cent skiodan. *Under direct fluoroscopic control the pelves and calices are filled by gravity.* When satisfactory visualization is complete the catheters are drawn down to a point about eight centimeters from the ureteral meati. The roentgenographic set-up is then thrown in quickly, the catheters are withdrawn, and the lower ureters slowly injected with one cubic centimeter of the opaque medium. The first film is taken as the catheters reach the bladder at the signal of the urologist. Two or three other films are then made as rapidly as possible. Exposure time varies from one-half to three-fourths of a second and the time between exposures eight to ten seconds. A residual film is made about ten minutes later. In cases of suspected ptosis a vertical film is taken after the last serial exposure.

The technic must be meticulous in detail. The roentgenologist must take time to prepare his eyes for proper fluoro-

scopy. The fluoroscopic part of the examination is not just an aid in the filling of the upper tract. Much valuable information can be obtained as to fixity of the urinary passages, the type of peristalsis, the relation of extra-urinary shadows, the movements of the kidneys with respiration, and the passage of the media down the ureter. It is frequently necessary to change the position of the catheter by withdrawing it slightly. Our object is to place the catheters as high as possible, with the ideal position of the catheter being in the kidney pelvis proper. The urologic member of the team frequently places one or both catheters in the superior calyx—quickly remedied under fluoroscopic vision. With a little practice the roentgenologist is able to estimate very accurately by the size and density of the shadow the amount of the opaque medium which flows into the pelvis and calices. At times, fluoroscopy easily answers the query as to why the pyelographic film is incomplete, a subject which will be considered later.

When proper attention is paid to detail, we seriously disagree with the objections to the use of retrograde methods in the study of function. If the objection is confined to the use of stronger and more irritating solutions, to the use of the obstructing catheter with the injection from below, or to the use of pressure, we agree that it is unphysiologic. When non-obstructing catheters are used, when the injection is made slowly by means of gravity, when non-irritating solutions are used, and finally when the amount injected is carefully controlled by fluoroscopy, we believe, after two and a half years' experience, that the information obtained is accurate and reliable. If at any time pain in the back is produced, the roentgenologist considers that he has made an error in interpreting the screen findings. The so-called defense mechanism of pain should not be obtained if the procedure is properly carried out. When such reaction has been elicited with this technic we have found it in cases where the kidney pelvis was atonic.

Jarre and Cumming (4) speak of pro-

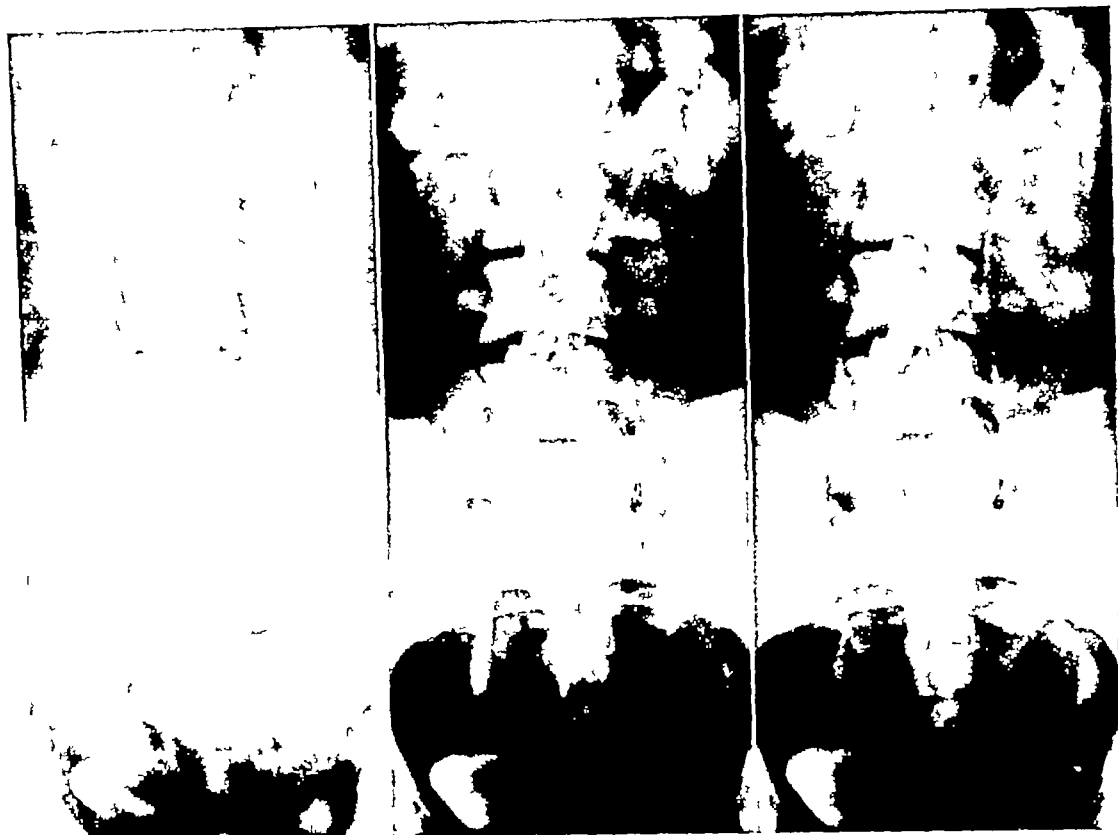


Fig 1

Fig 2

Fig 3

Figs 1, 2 and 3 Serial films in case of bilateral ureteritis showing fixity of lower ureters and dilatation above

peristalsis as the normal finding and anti-peristalsis as the abnormal or pathologic. In our normal cases we expect to see this type of pro-peristalsis where we obtain the anti-peristalsis with this method, roentgenographic evidence is obtained of pathology. These facts constitute an additional argument for soundness of properly made retrograde observations. They have certainly helped us on numerous occasions. When the opaque medium moves downward normally with no apparent reverse peristalsis or hyper-peristalsis and no apparent deviation in the rhythm, the examination is regarded as negative.

Elimination of pressure other than a small amount of gravity reduces to an absolute minimum the possibility of pylvous back-flow or of tubular injection.

There is one radiographic factor which is rarely mentioned and yet should receive

emphasis. Many films showing blurred outlines of the urinary tract are presented in texts and articles, the usual explanation being that of movement of the patient, yet bony detail and other soft tissue detail may be good. The correct explanation—that the blurring is caused by movements of the intestines—is seldom given. The roentgen exposure should be fast enough to stop this peristalsis. Pyelographic films for proper detail should be made as rapidly as possible. We hope to attain an exposure time of a tenth of a second in the near future.

The entire urinary tract is routinely included in the examination, a method which we feel is essential. When examination of the gastro-intestinal tract is made more errors are caused by incomplete examination than from any other reason, a fact which holds good for the urinary

tract also When the patient presents symptoms which call for a urologic survey, such a patient deserves a complete exami-

Fluoroscopy is both a guiding hand and a safety valve for this technic Overdistention can be prevented In cases of

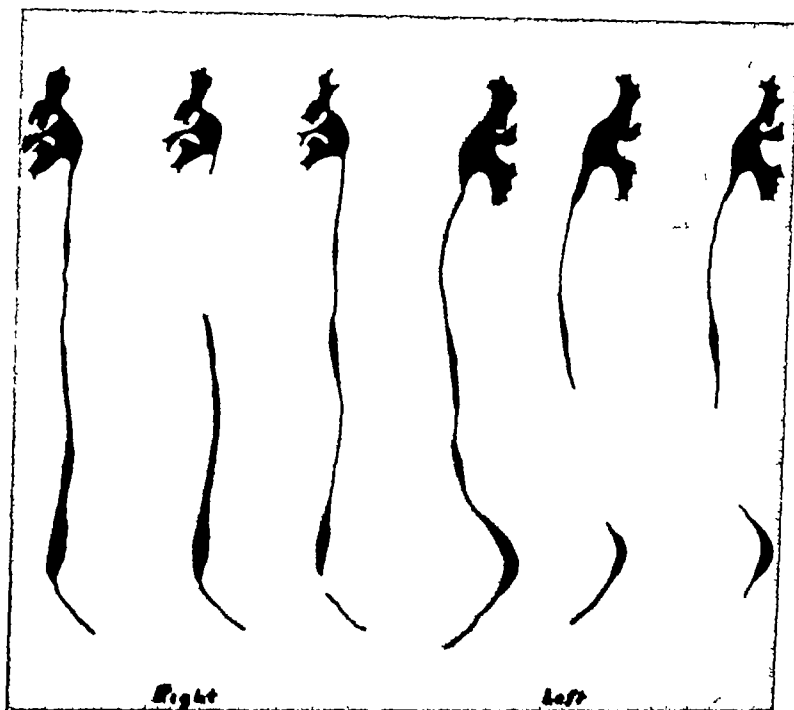


Fig 4 Silhouettes of the films in Figures 1, 2 and 3 showing the changes of ureters, pelves and calices in a graphic manner

nation Bilateral and complete examination, when proper methods are used, is not, in most instances, dangerous or disturbing to the patient In our own cases the present technic of complete examination is attended with much less discomfort than resulted from the old method of unilateral examination using sodium iodide for the opaque medium Many of the patients sleep through the procedure on their preliminary dose of morphine, except at the time the catheters are withdrawn

Case Report—Patient A. P., female, aged 26 years Chief complaint Hematuria (intermittent) Cystoscopy negative

SUMMARY OF CYSTOSCOPIC FINDINGS

	Bladder	Right	Left
Smear	0	0	0
Culture	Sterile	Sterile	Sterile
Dye		4 min	4 min

Diagnosis Bilateral ureteritis (Figs 1-4)

atony we have frequently shown that it can occur with a pressure of gravity of 8 to 10 inches, while without fluoroscopy there is no method that will prevent such an occurrence

The markedly hypertonic pelves and calices can be recognized fluoroscopically while from films alone the diagnosis of incomplete filling would be made When the rapid contraction of such a pelvis is seen on the screen and passage of the opaque medium down the ureter traced, another interpretation of the film is made We have seen such pelves and calices fill and empty in a fraction of a second, phenomena which cannot be recorded by present film technic

With multiple exposures the films portray different parts of a physiological cycle, a change more marked than is usually appreciated It is because of this change—it occurs in a matter of a very few

seconds—that we feel stereoscopic films to be of no value. In other words, each one of a stereo pair must present a different phase of the cycle, a fact which, of necessity, invalidates the stereoscopic examination.

At the same time, defects which are constantly present in several films are of much greater value than when seen on a single film. This is especially well seen in cases of non-opaque calculi, here the filling defects constantly present in the same location and of the same size are usually diagnostic.

Extra-urinary shadows are more easily evaluated in connection with complete visualization of the tract. This, we feel, is one disadvantage of the method of Moore.

Contrary to opinions expressed in the literature, multiple urograms showing the entire ureter have been of very valuable assistance in making diagnoses of pathology in the pelvis and calices. An atonic or fixed ureter frequently calls attention to a more or less fixed pelvis which, on a single pyelogram, appears normal. Again a pathologic lower ureter may focus attention on a dysuric type of pelvis such as described by Rose, Hamm, Moore, and Wilson (8).

The change or lack of change in size of the calices and pelvis gives us the most information. The hypertonic pelvis has been mentioned—if this is not too marked, the films will show it. The change in the calices and pelvis is visualized. Hypersecretion, which may cause an apparent rapid emptying that simulates hyperperistalsis, may cause error in interpretation, a fact to be noted by the urologist and warning given. Again, hypersecretion gives a slightly different picture fluoroscopically than hypertonicity.

In cases of block by stone or other pathology in the ureter the normal cycle is disrupted which can be easily recognized on serial exposures. The fixed ureter shows clearly. Segmental dilatation can be differentiated from waves of peristalsis. Cases of stone show the accompanying ureteritis

with this technic. The method has been helpful in the recognition of early tuberculous lesions, and we have also observed apparent attempts at peristalsis in advanced tuberculous ureteritis.

The so-called kinks of the ureter show as loopings of an elongated ureter. This, of course, does not include a fixed kink in the ureter due to inflammatory disease. With multiple films the so-called kink presents a different appearance on each film.

To us, the greatest value of this technic lies in the help it yields in recognizing inflammatory lesions. Jarre (4) has described an early hypo-peristalsis in acute infections. This we have not seen, however, none of our cases has been cystoscoped during the very acute stage. This observation of Jarre was obtained during intravenous pyelography which could be done safely during the acute period. Our early finding is a varying state of hyperperistalsis. This, as stated before, may be so marked as to prevent the securing of a good pyelogram, while later in the process the involved portion of the tract shows a fixed appearance, either in a state of dilatation or contraction.

This fixity is seen most commonly in lesions of the lower ureter. The constant finding of a narrow lower ureter, with the peristaltic waves coming down to but not through this area, is, we feel, diagnostic of a peri-ureteritis in this location. There may or may not be some dilatation of the ureter above this point. Such a condition is fairly common in adnexal disease of both male and female. Unless careful urograms are done this condition is missed entirely—with but a single exposure it is impossible to tell whether the narrowing is due to peristalsis or disease.

In conclusion, the method herein described is not final. We are continually adding to, and changing, our technic as our knowledge increases. A similar technic of rapid serial exposures is now being applied to intravenous examination. Plans have been made to increase the number of serial films and decrease the time between exposures, our aim being a practical routine

plan which will depict function as well as anatomy

SUMMARY

A method of complete examination of the urinary tract is described

The necessity for team-work between the urologist and the roentgenologist is emphasized

A definite attempt is made toward functional as well as anatomic diagnosis

For the writers, the technic constitutes a definite advance in routine diagnostic roentgenology in the field of urology

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UROLOGIC PROBLEMS IN CHILDHOOD¹

By WILLIAM J ENGEL, M D , Cleveland Clinic, *Cleveland, Ohio*

THE problems presented by diseases of the urinary tract in children have a right, I think, to be segregated from the other problems with which the urologist is confronted, not only because these diseases in childhood differ in many respects

¹ Read before the Radiological Society of North America at the Twentieth Annual Meeting, at Memphis Tenn Dec 3-7 1934

from those in adults, but also because attention is thus directed to lesions in the urinary tract in children which are all too often overlooked. Many phases of urinary diseases in children might be discussed, but I have chosen to emphasize certain problems relating to the upper urinary tract.

Urologic diagnosis in infants and young

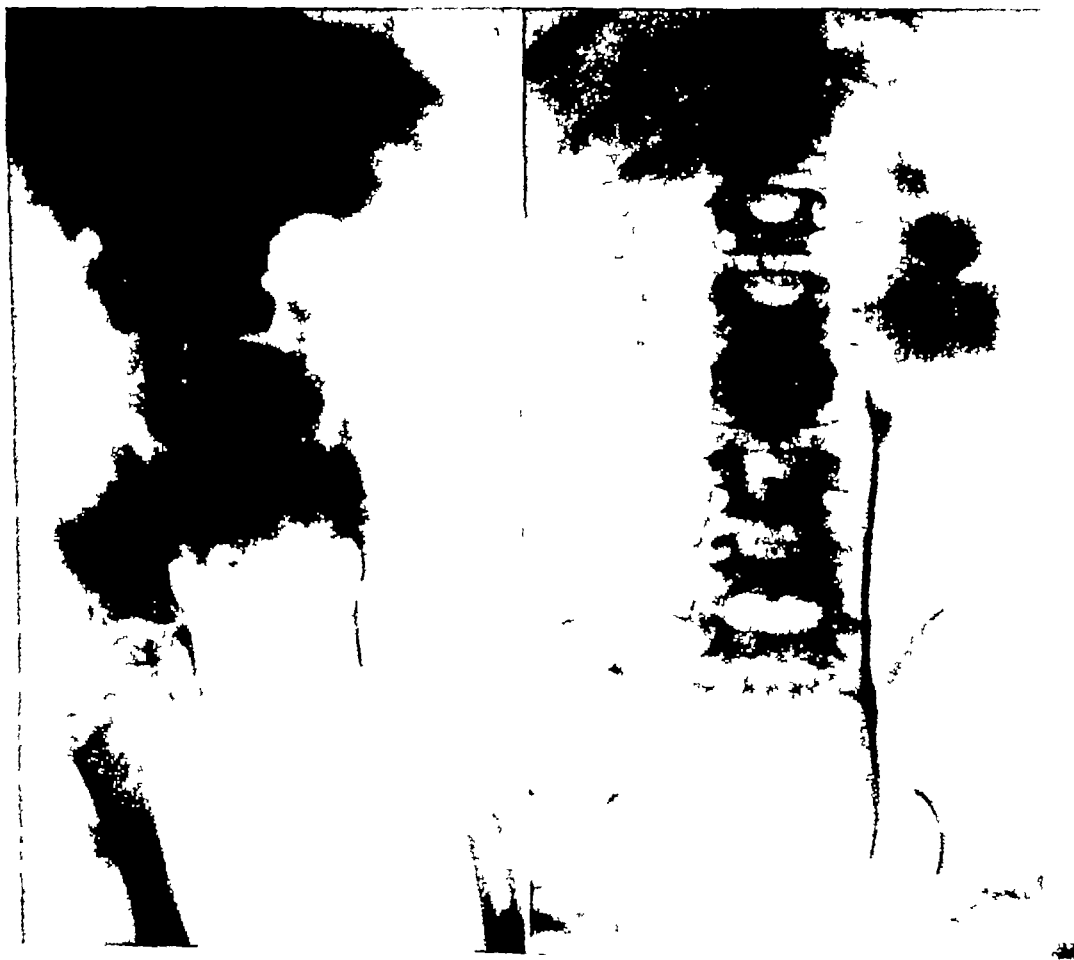


Fig 1 The patient was a girl four and one-half years of age who had had pyuria for three years. Roentgenogram shows a large calculus in the right kidney.

Fig 2 The patient was a girl nine years of age. Roentgenogram shows calculous pyonephrosis of the right kidney and hydronephrosis of the left kidney, due to an aberrant artery.



Figs 3 A and 3 B The patient was a boy twelve years of age Fig 3 A (left) Plain roentgenogram shows a shadow in the region of the right ureter Fig 3 B (right) Intravenous urogram shows the shadow to be a calculus in the ureter There is hydronephrosis of the right kidney

children is rendered more difficult because of the impossibility of eliciting subjective symptoms accurately and because physical examination is so often unsatisfactory. The diagnostic methods, however, differ in no way from those employed in adults, and roentgenologic examinations play a major rôle in all cases. Every child who is suspected of having some disease of the urinary tract should have a preliminary stereoroentgenogram of the kidneys, ureters, and bladder, followed by additional

studies according to the individual indications.

When intravenous urography was introduced it was hoped that this would solve the problem of urologic diagnosis in children, but it has not completely met these expectations. Although it is employed more or less routinely as a preliminary investigation, it has been, on the whole, rather disappointing as regards final diagnosis and in many instances it has been necessary to resort to cystoscopy and retrograde pyelography before any final decision could be reached. This experience is supported by Campbell's recent report of 304 urograms in children, of which only 47.5 per cent were of diagnostic value and only 7 per cent furnished the correct diagnosis without further study. I do not mean to underestimate the value of intravenous urography. It has been of tremendous assistance, but one must be prepared to proceed further in that considerable group of cases in which intravenous urography does not yield conclusive diagnostic evi-

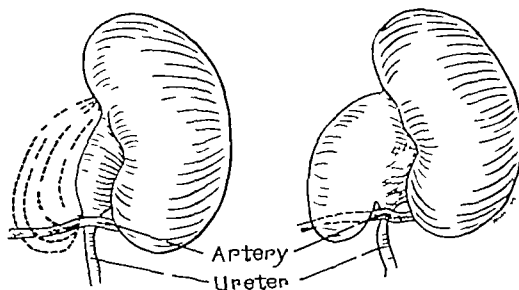


Fig 4 Schematic drawing, showing successive stages of dilatation of the kidney pelvis over an aberrant artery



Figs 5 A and 5-B The patient was a boy nine years of age. Fig 5 A (left) Retrograde pyelogram shows marked hydronephrosis and almost complete destruction of the kidney tissue. Fig 5 B (right) Photograph of specimen showing marked hydronephrosis due to aberrant artery which is well demonstrated.

dence. There should be no hesitancy in proceeding to cystoscopy, ureteral catheterization, and retrograde pyelography. Cystoscopy can be safely carried out, no matter how young the patient, and in gentle hands does not increase the hazard.

I shall now discuss some of the specific problems presented by the different diseases of the upper urinary tract in children. These may be grouped under three headings: (1) urinary calculi, (2) upper urinary lesions of congenital origin, under which I have included aberrant arteries, congenital megalo ureter, and ureterovesical stricture, and (3) kidney tumors.

URINARY CALCULI

Urinary calculosis is not common in children when compared with the incidence of this condition in adults. In a series of

1,388 cases of urinary calculi seen at the Cleveland Clinic there were 17 cases in children under fifteen years of age, or an incidence of 1.2 per cent. As in the case of adults, stones may occur anywhere along the urinary tract. In our group of cases there were seven in the kidney, seven in the bladder, one in the bladder and kidney, two in the ureter only, and one in the kidney, bladder, and ureter.

The clinical picture differs in no way from that seen in the adult. Pain, of course, is the outstanding symptom. In children, however, this is much more frequently associated with rather marked gastro-intestinal symptoms, such as nausea and vomiting, and often muscle spasm of the abdominal wall. This may lead to considerable confusion in diagnosis and an intra-abdominal lesion often is suspected in these cases. The findings of pus cells



Fig 6 The patient was a boy sixteen years of age. Roentgenogram shows bilateral hydronephrosis due to an aberrant artery.



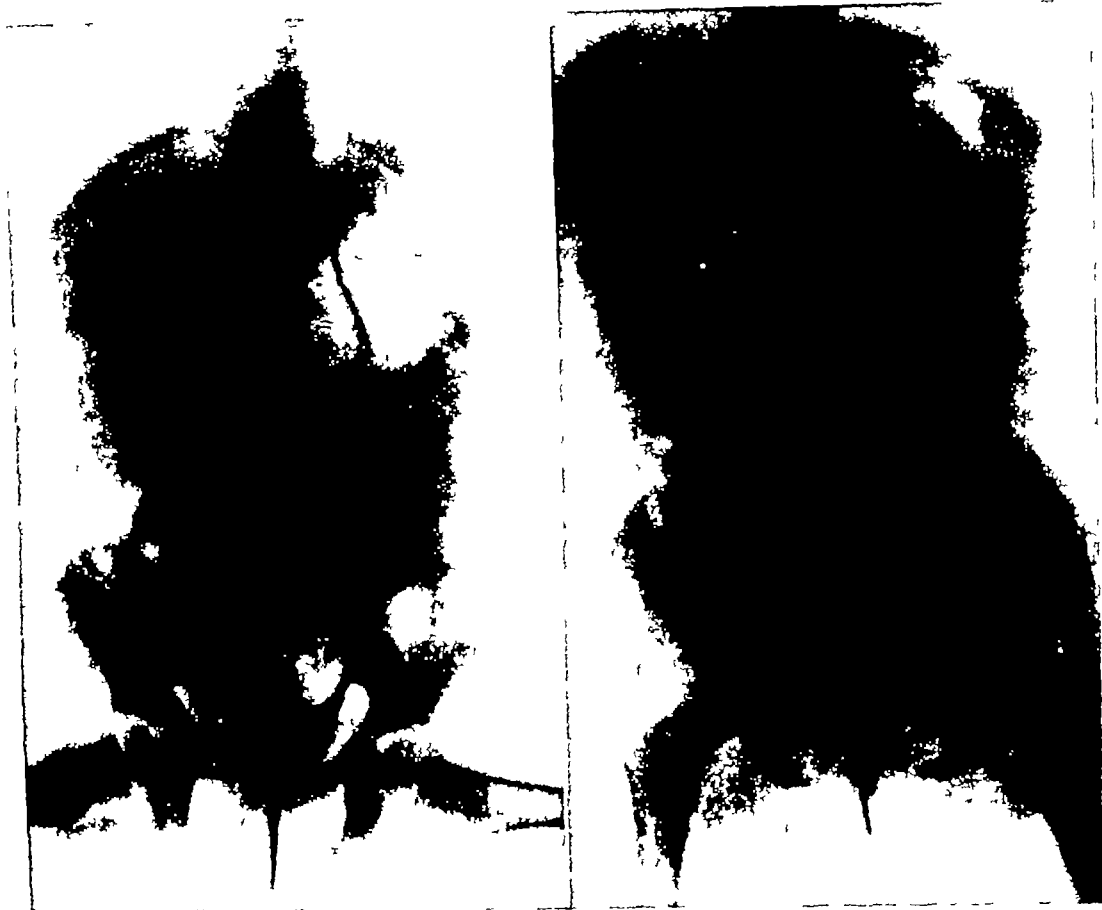
Fig 7 The patient was a boy fifteen years of age. Retrograde pyelogram shows hydronephrosis due to an aberrant artery. Complete relief of symptoms was experienced after conservative operation.

and red blood cells in the urine, however, should lead one to suspect the true nature of the trouble. Persistent pyuria, especially, should lead to the suspicion of kidney stones. In all cases in which this symptom is present, a plain roentgenogram should be made. This will show stones in the vast majority of instances (Figs 1, 2, 3-A, and 3-B).

When there is a stone in the bladder the diagnosis is sometimes confused by the presence of urinary incontinence and enuresis. Some neurogenic cause of these symptoms is often wrongly suspected and an erroneous diagnosis of cord lesion or spina bifida may be made. The intense dysuria, however, should always suggest

the possibility of stone in the bladder. The diagnosis, of course, is made finally by the finding of stone shadows in the plain roentgenogram of the kidneys, ureters, and bladder. Although this diagnostic method is available to practically every practising physician, it is amazing to see how often urinary stone goes unrecognized in children.

With improved knowledge of diet and infant feeding the incidence of stone in children has shown a sharp decrease in those countries where it formerly was quite prevalent. The work of McGarrison, Osborn and Mendel, Higgins, and others, showing that urinary calculi develop in a large proportion of rats fed on



Figs 8-A and 8-B This is a case of congenital megalo-ureter. The patient was a girl, three years of age, who had had chills and fever since she was four and one half months of age. Fig 8-A (left) Right pyelogram. Fig 8-B (right) Left pyelogram shows bilateral dilatation of ureters. Bilateral vesicorenal reflux was demonstrated later by cystogram.

a diet deficient in vitamin A, forms the basis of this improved dietary management. Much has been accomplished in the way of prevention of stone in children, but there are unquestionably other factors beside diet which enter into the production of urinary calculi, and until these are elucidated, we cannot hope that urinary lithiasis can be prevented.

Treatment of urinary stones in children is almost entirely surgical. The type of operation, of course, depends upon the requirements of the individual case. Even in the case of ureteral stone, cystoscopic manipulation is often impossible in children and ureterotomy should be performed at once. The surgical removal of the stone, however, does not discharge the obligation of the urologist and he should

then look to prevention of recurrence. It is here that the proper diet and high vitamin A intake achieve great usefulness. These patients should receive a high vitamin, acid ash type of diet, with the hope of forestalling recurrence of the calculi.

URINARY LESIONS OF CONGENITAL ORIGIN

Hydronephrosis due to aberrant artery is a relatively common disease and its recognition in childhood is a thing earnestly to be desired. Symptoms are not likely to appear early, the youngest patient we have encountered was a six-year-old boy. The incidence of aberrant renal arteries is, of course, much higher than that of cases in which there is a resultant hydroneph-



Fig 9 The patient was a boy eight years of age who had had recurrent attacks of chills and fever, associated with pyelitis since he was six months of age. Retrograde pyelogram shows dilatation of the kidney pelvis and ureter with ureterovesical stricture.

rosis. It has been estimated that aberrant renal arteries are present in about 20 per cent of all persons. Only 20 per cent of these, however, are at the lower pole and hence capable of producing urinary obstruction.

The embryologic explanation of the occurrence of aberrant vessels is that the kidney in its ascent to its final location receives its blood supply from successive levels, with obliteration of each previous artery. Failure of this process at the final level allows the vessel to remain patent, and if it is situated at the lower pole, is capable of producing urinary obstruction.

It would not appear that ptosis of the kidney or inflammatory stricture must be presumed in order to explain the production of hydronephrosis in these cases. These aberrant arteries are always associated with fibrous peri-ureteral bands, also of congenital origin, and the combination constitutes a fixed point which interferes with normal peristalsis. This results in gradual dilatation until finally the pelvis becomes redundant over this fixed point and thus establishes a vicious cycle which increases the amount of obstruction (Fig 4).

These cases are overlooked with striking frequency, a failure of recognition which is caused, I believe, by the usual absence of positive urinary findings. In fact, many of our patients with aberrant renal arteries have had perfectly clear urine. In a young person, persistent kidney pain, often most severe in the morning and waning through the day, with tenderness over the affected kidney, should always suggest the presence of this lesion. The pain is usually a dull aching and very seldom appears as colic. Gastro-intestinal symptoms may predominate. There is, of course, no way to make a positive clinical diagnosis without the aid of the roentgen ray. An intravenous urogram should be the first procedure and in almost every instance will yield a positive diagnosis. Of course, the intravenous urogram is of no value in those cases in which kidney function has been completely destroyed (Figs 5-A, 5-B, 6, and 7).

Surgical intervention is demanded when this condition is recognized, and if the patient is seen before extensive kidney destruction has taken place, a conservative operation may be employed. We have preferred the simple division of the artery with or without plication of the dilated pelvis and have had completely satisfactory results by this method. All too often, unfortunately, the process has gone beyond the stage at which the conservative operation will suffice, and nephrectomy is required. In our series of 29 cases, nephrectomy was necessary in 50 per cent of the cases in which operat



Figs 10 A and 10 B The patient was a boy fourteen years of age A (left) and B (right) Bilateral pyelograms, showing marked hydro ureter and hydronephrosis (left) Obstruction in this case was due to congenital bilateral ureterovesical stricture

Congenital mega-ureter is a term applied to a small group of cases with bilateral ureterectasis which occurs in the absence of lower urinary obstruction. These cases must be differentiated from those with congenital posterior urethral valves, hypertrophied verumontanum, etc. That the condition must be congenital is apparent from the very early age at which it has been recognized, together with the fact that it may occur in the absence of any obstructive lesion. The exact mechanism of its production is not clear but it would seem to be due to some congenital neuromuscular failure, with persistence of a fetal type of ureter. It differs from hydro-ureter in obstructive lesions in that the latter is associated with hypertrophy of

the ureteral musculature and marked tortuosity, an evidence of hyperperistalsis.

Urinary infection usually is responsible for bringing these patients for medical attention and this may appear when the child is very young. Recurrent infection is the rule, until the true nature of the disease is finally disclosed by a complete urologic investigation. At this time cystoscopy reveals wide patulous ureteral orifices which allow bilateral ureteral reflux. Injection of a pyelographic medium shows widely dilated ureters which, in the later stages, may be somewhat tortuous. Oddly enough, the kidney pelvis often shows only moderate dilatation, not at all comparable to the extent of dilatation in the ureter.

The treatment of this condition consti-

tues a real problem. Operation is of no avail and the task is to control the infection. Drainage by inlying ureteral catheter

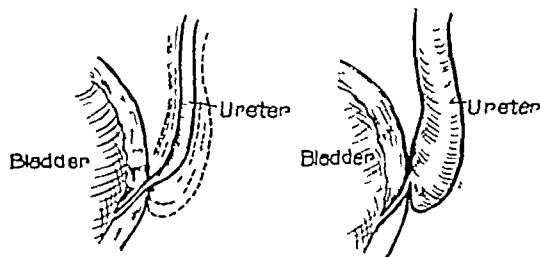


Fig 11 Schematic drawing showing how dilatation of the ureter above a urterovesical stricture may produce valve like deformities

ter may be necessary in the more severe acute phases of infection, and periodic lavage of the kidney pelvis is at times a useful procedure. I have always felt, however, that a minimum of instrumentation should be employed, and that an attempt should be made to clear up the infection by means of a ketogenic diet and urinary antiseptics.

The prognosis in these cases is very bad and the patients almost never live to reach adulthood. There is a progressive kidney insufficiency, hastened by infection, and uremia is the terminal event (Figs 8-A and 8-B).

Ureterovesical stricture presents quite a different problem in that a definite obstruction caused by a congenital stricture at the vesical end of the ureter is the cause of the ureterectasis. These strictures may be unilateral, as in the case I present here (Fig 9), but bilateral lesions of this type also occur (Figs 10-A and 10-B). Cystoscopic examination in these cases reveals a small ureteral orifice in contrast to the large patulous ureter of congenital megalo-ureter. An attempt at ureteral catheterization may be attended with some difficulty. Similar cases have been described as due to congenital valves in the ureter, and though this possibility must be granted, I have a feeling that many cases in which the condition is attributed to the presence of valves, simply represent the dilatation of the ureter above a stricture which re-

sults in a valve-like appearance (Fig 11). It is true, of course, that this resulting deformity acts to increase the amount of obstruction already present.

Here again, it is the presence of infection which demands medical attention. The infection usually is ushered in by chills and fever, and varying degrees of kidney pain and tenderness are constant accompaniments. The finding of pus in the urine usually results in a diagnosis of pyelitis, but repeated incidents of this type finally bring the patient for thorough urologic study. The intravenous urogram usually suffices to determine the diagnosis. This shows a dilated ureter with constriction at the lower end and usually retention in the kidney an hour after injection of the dye. In some cases there may be delayed function and the differential phenolsulphonephthalein test shows diminished function on the affected side.

The treatment consists in the surgical relief of the obstruction. Good results may be expected if the process is not too far advanced. The ureter may not return to its normal size, but if drainage is free the patient will be well and no further kidney damage will result. In late, neglected cases, ureteronephrectomy may be necessary.

MALIGNANT TUMORS OF THE KIDNEY

Malignant neoplasms of the kidney in children present one of the most depressing problems in urology because there is so little we can claim to have accomplished for these poor unfortunates. Fortunately the incidence of these growths is not high, it having been estimated that only one child in 1,600 is affected by a kidney tumor. However, among malignant tumors occurring in children, 20 per cent are in the kidney and among all cases of kidney tumors, the incidence in children is about 12 per cent. At the Cleveland Clinic since 1920 we have records of 32 cases of kidney tumor in children, 16 of which have been verified by operation and pathologic examination.



Figs 12 A and 12 B The patient was a girl three and one half years of age who when she was admitted to the hospital complained of hematuria, chills and fever Fig 12-A (left) Retrograde pyelogram shows a filling defect in the lower pole of the right kidney Fig 12 B (right) Photograph of specimen removed showing a Wilms tumor, involving the lower half of the kidney

It is not within the scope of this paper to discuss at length the theories regarding the pathogenesis or the pathology of these tumors but a few remarks are pertinent to the subject. These growths are all mixed, undifferentiated tumors arising from embryonic tissue, and are characterized by very rapid growth. They present a varied pathologic picture and any one of a variety of forms may occur, depending upon the type of tissue which predominates. It is truly a problem of survival of the fittest and the strongest and most rapidly growing tissue elements take the field. This explains the many pathologic names applied to these tumors, but clinically they are a single entity, well known in their behavior, and may from our standpoint quite properly be grouped under one term malignant kidney tumors of childhood.

These growths occur in very young children and have even been reported in

fetuses and newborn infants. The vast majority make their appearance before the fifth year of life, some collected series show an incidence as high as 98 per cent, but in our group of cases only 70.8 per cent occurred in children under five years of age (Figs 12-A and 12-B).

The presenting symptom or complaint is usually an abdominal tumor which has appeared rather suddenly and has grown rapidly. The longest history we obtained was of six months' duration and this patient had a very large inoperable tumor. Chills and fever are not uncommon and pain is a frequent complaint. Hematuria is a relatively infrequent symptom and occurred in only two of our cases.

The diagnosis usually offers no difficulty when one considers that about 90 per cent of the patients present themselves with a palpable tumor mass in the kidney region. Kidney tumor is by far the most common cause of a large tumor mass in a child.

In the remaining 10 per cent of cases hematuria, kidney pain, and the symptoms of urinary infection should direct one's attention to the urinary tract and further investigation and pyelograms disclose the true nature of the disease

The results of treatment of these tumors must impress all who have seen any number of these cases as very discouraging. No matter what treatment is adopted,

that is, operation, irradiation, or both, the outcome is nearly always fatal and this usually within a very short time. It is truly remarkable to see how some of these large tumors melt under irradiation therapy like fat before the fire, but this, unfortunately, does not improve the prognosis, for they recur rapidly and become more radioresistant

MALIGNANT TUMORS OF THE KIDNEY IN CHILDREN¹

WITH A REPORT OF SIX CASES

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INTRODUCTION

DURING the past four years 34 patients with kidney neoplasms have been admitted to the University Hospital, at Madison, Wisconsin, six of these occurred in children under the age of 6 years and some belonged in all probability to the group of embryonic tumors very often called Wilms' tumor of the kidney. Since they are not very common and present a rather complex problem to the clinician and as the literature does not offer much information concerning treatment, the cases seen by us will be analyzed and certain conclusions offered regarding roentgen therapy.

PATHOLOGY

The nomenclature of the tumors under discussion is a matter of some confusion at present. Before 1894, many authors reported tumors of the kidney consisting of varying types of cells, in that year, however, Birch-Hirschfeld (1), reviewing the literature and describing several cases of his own, gathered these various neoplasms into one group, the common characteristic being the occurrence of more than one type of tissue. The usual picture was that of tubular tissue combined with various types of connective tissue, both of an embryonal character. He called them, therefore embryonal adenosarcomas.

In 1899 and the following years, Wilms (2) investigated thoroughly the structure of the renal mixed tumors and published a three-volume monograph on the subject. The greater extent of his publications and the shortness of his name have perhaps been factors in attaching his name to these

tumors rather than that of Birch-Hirschfeld.

The designation, "Wilms' tumor," however, has come to be applied loosely—perhaps chiefly in a clinical sense—to any renal tumor of primitive or embryonal nature, and especially to those found in children. This usage has thrown somewhat into obscurity a type of neoplasm which, though rare in comparison with mixed tumors, occurs with sufficient frequency to warrant its consideration whenever the diagnosis of a renal tumor in a child is in question, namely, embryonic carcinoma. Ewing (3) discusses this as a separate entity, but mentions the possibility of its relation to the mixed tumors.

The mixed tumors occur chiefly in young children, usually under 10 years, though they are also found in adults. They are not infrequently bilateral, and occur in any part of the kidney. The size naturally varies with the age of the tumor at the time of its discovery. Since it is usually first detected as a palpable mass in the kidney region, it is generally described as a massive neoplasm. The tumor tissue is usually sharply demarcated, but may be infiltrative in character. The gross structure is extremely variable, and may include hemorrhage, necrosis, and cartilage or bone formation as special features. Invasion of the renal vein sometimes occurs and may be followed by early and widespread metastasis.

Microscopically the picture is even more variable. The common feature, as stated above, is the presence of both epithelial and connective tissue elements, each participating in the malignant character of the neoplasm. The epithelial portions consist characteristically of tubules, often abortive in nature but suggesting kidney tubules.

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The epithelium forming them is usually of high columnar variety, with a definite lumen and in some cases a well-defined basement membrane. On the other hand, all gradations of differentiation have been reported, from primitive-appearing groups of round cells, described as the mesodermal forerunners of renal epithelium, to abortive attempts at glomerulus formation.

The connective tissue elements may also present an exceedingly complex picture. Primitive connective tissue is always present, and this apparently is not in the least limited as to its power of differentiation, for the greatest variety of connective tissue types may be found. Fibrous connective tissue, elastic tissue, fat, bone and cartilage, and finally muscle, either smooth or striated, may appear, and many of these may be present in the same tumor. The most constant type is muscle, usually striated. This, in rather primitive stages, combined with epithelium forming imperfect tubules, presents the most frequently seen picture, although, as stated above, endless variety is possible.

Metastases are most often found in the liver and lungs, and their structure may be similar to that of the primary tumor, or may contain only one cellular element.

The question of histogenesis is at present unsettled. The origin of the tumors has been assigned to various sources, for instance, the Wolffian body (Birch-Hirschfeld) and the primitive mesenchyme (Wilms). It is probably wise, however, on account of the extreme variation of structure, to concur with Ewing in not postulating a uniform origin for all the tumors in this group.

SYMPTOMS

Tumors of the kidney in children produce, as a rule, no symptoms until the growth has reached considerable size. In contrast to hypernephroma, these highly malignant neoplasms seldom cause hematuria early in their course, and the absence of pain also tends to prevent their early discovery. Sometimes the patient's vague gastro-intestinal symptoms induce the par-

ents to bring the child to the physician, who, on palpation, finds a good sized mass in the left or right abdomen (Cases 2 and 5). In an early stage, tumors on the right may easily simulate appendicitis (Case 2). It is also possible that a bulging of the abdomen may be mistaken for adipositas or a hernia (Case 4) or that sudden hematuria (Case 1) may reveal the true nature of the disease.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The diagnosis of a fully developed kidney tumor in a child is usually not difficult. The palpation of a large mass in the kidney region leaves little doubt as to its probable origin. In the differential diagnosis pyelography and intravenous urography are of great assistance, both can be carried out with relative ease in children. If enough kidney tissue has been destroyed, there is non-visualization of the involved side following intravenous injection of the dye. Retrograde pyelography shows filling defects of varying size and irregularity, some times also an abnormal position of the ureter. Even a single film of the abdomen may definitely localize the tumor mass within the kidney area. While it may be difficult to differentiate very large kidney neoplasms from retroperitoneal tumors of other origin, the clinical data, supplemented by the radiological findings, permit one to establish the diagnosis.

PROGNOSIS

The prognosis of kidney tumors in children is extremely poor. While an occasional patient may survive, it appears from all available data that the mortality is well above 90 per cent. Hyman (4) states that 17 of a total of 163 cases of kidney neoplasms belonged to the group of Wilms' tumor, only one of the 17 patients survived operation by a few years. Of nine patients with Wilms' tumor of the kidney seen at Roosevelt Hospital in New York, seven died within the first year following operation, one was alive after four years but could not be traced further. One patient (reported by White, 5), operated

on in 1925 at the age of seven months, was living in 1931. The experience of observers on the Continent is similar (Demel, 6).

TREATMENT

Before the advent of high voltage therapy the treatment of kidney tumors in children was entirely surgical. Since they are composed largely of embryonic tissue it seems logical to assume that they are radiosensitive. Clinical experience has indeed shown that marked reduction in size may be brought about by roentgen therapy. Only recently Randall (7) has drawn attention to this fact and recommended pre-operative irradiation in all cases of this type, followed by removal of the residual mass four to six weeks later. In two out of three cases the procedure proved to be of definite benefit. We feel that the interval between pre-operative irradiation and operation should be determined according to the individual requirements of each case, and find it impossible to propose a definite period. As soon as the tumor has been reduced to such an extent that it is barely palpable, and provided the general condition of the patient is satisfactory, removal of the remaining tumor may be attempted. Hyman, though he does not believe in irradiation of adult kidney neoplasms, also feels that pre-operative roentgen therapy is indicated in Wilms' tumors. We would like to emphasize the statement that prophylactic treatment should follow successful removal of any residual tumor mass.

The technique of treatment is simple. As a rule one anterior and one posterior field suffice, in very large tumors a third lateral field can be added. The question of dosage is a matter of debate. Randall used about 500 r over two areas applied during approximately two weeks, we have administered less in our patients. Even with relatively small doses we experienced violent systemic reactions—so severe as to force interruption of the treatment (Cases 1 and 2). A very poor general condition (Case 3) with a low blood count also ren-

ders moderate or small doses advisable. We see no particular objection to the use of smaller doses since we are dealing with a highly radiosensitive neoplasm. One must also remember that a too rapid breakdown of tumor tissue is very apt to produce severe symptoms of intoxication, the response of the tumors to irradiation in our own patients seems to bear this out. As to the prophylactic irradiation of the sites of future metastases we are somewhat reluctant to proceed. It is impossible to predict, for instance, how much benefit one may obtain from producing fibrosis in the mediastinal glands and thus depriving a patient of normal lymphatic tissue. To what degree such an area may be rendered non-fertile for the development of a metastatic lesion is beyond prediction.

In case of severe pain, roentgen therapy may bring palliation (Case 6) and is, therefore, indicated. We do not recommend treatment of the metastatic lesions in the lungs, although theoretically they should respond because of the radiosensitivity of the primary tumor. However, once the metastatic process has started, it seems to spread so rapidly that therapy appears rather futile. We are also very sceptical as to a "spontaneous" regression of a secondary neoplasm in the lungs.

REPORT OF CASES

Case 1. M. H., X-ray No 1748, male, 5 years old, was admitted to the Wisconsin General Hospital, Section on Pediatrics (Dr J. E. Gonce) on July 18, 1931. The parents had noticed that for two years (?) the boy's stomach was unusually large. They had not been especially worried about this, since he had no symptoms of any sickness during this time. A few days before admission to the hospital the patient passed bright red blood following urination. The boy was taken to a physician who found a tumor in the abdomen and advised hospitalization. The parents did not recall any symptoms which might have been related to this condition aside from a sallow color which had been present

at various times during the preceding two years. Past medical history included only whooping cough at one and a half years of age. The family history was irrelevant.

Physical examination showed a fairly well nourished and well developed boy. In the right side of the abdomen was a large, nodular, very irregular mass, extending from the costal margin down past the umbilicus and past the midline. It was very firm but not tender. It did not move with respiration and was quite immovable on palpation. Physical examination was otherwise essentially negative.

Urinalysis and routine blood count were normal. A phenolsulphonaphthalein test was done and showed 45 per cent excretion in the first hour and 5 per cent excretion in the second hour. X-ray examination of the abdomen revealed a large tumor mass on the right side, apparently arising from the right kidney and displacing the intestines to the left; the left kidney was visualized partially. A pyelo-ureterogram was taken and showed a normal left kidney. There was a small amount of dye showing in the mid-portion of the right kidney. A diagnosis was, therefore, made of right kidney tumor, probably sarcomatous in nature. X-ray therapy was started immediately and given in as large doses as the patient would tolerate and as often as he would tolerate them. The following x-ray deep therapy technique was used, H V L in Cu, 0.95 Å, 100 r (in air) per sitting, anterior and posterior right kidney area, one field per day. After three sittings the patient developed fever, nausea, and symptoms of marked intoxication. Treatment had to be interrupted for two weeks. In spite of the relatively small dose administered the mass appeared to be definitely smaller. Treatment was continued until six exposures had been applied over both anterior and posterior kidney areas. At the time of discharge from the hospital there was marked reduction in the size of the growth. The patient returned in November and again received six fields of 100 r (in air) each, both anteriorly and posteriorly. At the end of

December no tumor mass was palpable. It was decided, therefore, to remove any residual mass surgically. The hemoglobin at that time was 60, there had been no loss nor gain in weight.

Operation, Jan 5, 1932 (*Dr I R Sisk*) — The kidney was exposed through the usual right flank incision. The neoplasm was larger than it had been thought, from physical examination, to be, it had developed in the upper pole and displaced the pelvis and remaining kidney downward. Considerable bleeding was encountered as a result of the friability of the renal vein. This, however, was completely controlled, and the kidney with the entire tumor was removed. Blood transfusion of 300 cc was given.

Histologic Examination — The tumor is made up chiefly of acini of which some have a definite lumen and resemble tubules or glandular structures, while others are solid. The cells of the tubular acini are almost uniformly of very high columnar type. In the more solid acini, the cells are irregular in shape, though fairly uniform in size. They are not so elongated in general as in the tubular portions, but are more polyhedral in shape. The nuclei, in general, stain lightly, with only occasional nucleoli. The stroma consists for the most part of delicate strands of connective tissue carrying small blood vessels, though here and there heavier connective tissue septa can be seen containing large vessels. A heavy connective tissue capsule is present and in the histologic sections examined this has not been invaded (Fig 1). A large part of the mass consists of a dense vascularized connective tissue matrix in which are embedded cells reminiscent of the polyhedral tumor cells described above, though not definitely identified as such. A few tubules lined with cubical epithelium are found here.

This may be described as a renal adenocarcinoma of somewhat primitive type, but is not a typical embryonic tumor of the kidney. The heavy connective tissue growth in some parts is characteristic of irradiated tissue, but certain portions of

the tumor do not seem to have been affected by roentgen therapy

On Jan 17, 1932, the patient developed a temperature of 102° , there was a small sinus at the site of the drainage in the

who suspected appendicitis On October 22, the mother first noticed a mass on the right side, and on December 5 blood and pus in the urine No dysuria, frequency, or nocturia No history of childhood



Fig 1 Case 1 Photomicrograph of tumor removed following x ray therapy (220 X) For description see text



Fig 2 Case 2 Photomicrograph of tumor removed following x ray therapy (220 X) For description see text

wound Another transfusion of 300 cc was given on January 18 The patient recovered sufficiently to receive additional x-ray deep therapy starting on Feb 1, 1932 He returned on March 18, when he appeared to be in good physical condition The parents stated that he had been acting as a normal child and was eating well Examination showed a lump of large walnut size in the upper right iliac fossa, slightly movable and not tender on pressure Treatment was instituted immediately, but when the patient returned in April he was cachectic (had lost weight, looked very anemic) and the tumor had slightly increased in size He died at his home in May, 1932 No autopsy permit was obtained

Case 2 R K, X-ray No 1966, female, aged three and one-half years was admitted to a Madison hospital on Dec 15, 1931 The patient's mother stated that about Oct 20, 1931, the child fell and complained of pain On the following morning she began to vomit and in the afternoon had a temperature of 103° degrees and abdominal pain A physician was consulted

diseases Birth weight had been eight and three-fourth pounds The child had been gaining normally intelligence good Physical findings were essentially negative except that the right kidney was greatly enlarged, freely movable and not tender, extending almost into the pelvis The liver was palpable 2.5 cm below the right costal margin The blood count showed slight anemia, albumin and red blood corpuscles were found in the urine The child was referred by Dr I R Sisk to the Wisconsin General Hospital for x-ray deep therapy Five exposures of 100 r (in air) each were given over the anterior and posterior right renal area on five successive days On Jan 11, 1932, the tumor had so much decreased in size that surgical removal of the residual mass was carried out

Histologic Findings—This tumor is apparently greatly changed by irradiation, and therefore its original nature cannot be determined with certainty It is composed of tubular acini of low cuboidal epithelium, with extensive edema and hemorrhage of the stroma No mitotic figures



Fig 4 Case 4 Roentgenogram of chest taken June 10, 1931, showing metastases in lungs



Fig 5 Case 5 Intravenous pyelogram taken Feb 22 1933 Arrow points to small amount of dye on involved side.

relevant The present condition began on Feb 14, 1932, when the patient suddenly fell to the floor without losing consciousness She vomited immediately after this and appeared to have a fever Vomiting continued for several days and the patient then began to complain of pain in her left side, at which time a tumor mass was noted The parents remembered that the child had complained vaguely of a fullness in the abdomen on the left side since December, 1931 In the two months before admission the child had lost seven pounds in weight, and her appetite had been very poor Nothing unusual had been noticed about the stools or urine except that the urine was somewhat scant in amount The family physician examined the child in September, 1932, at which

time there was no abdominal mass present Two months later, however, a large tumor could be palpated Physical examination showed a poorly nourished, pale infant, who was lying quietly in bed, appearing to be prostrated and very weak Examination of the abdomen revealed a prominence in the upper left quadrant of the abdomen A large tumor mass was palpable, extending past the mid-line on the right and inferiorly down beyond the umbilicus, very firm, with rounded edges On the medial aspect no notch could be palpated The upper pole of the mass seemed to fade out under the costal margin It was not movable, did not change position with respirations, and did not seem to be particularly tender Physical examination was otherwise essentially negative X-ray

studies of the chest showed no evidence of tumor metastases or other pathology. X-ray examination of the kidneys, ureter, and bladder was unsatisfactory aside from showing the mass described above. An intravenous pyelogram was performed on Feb 22, 1933, and a normal kidney and pelvis were visualized on the right side. On the left, a dense large mass was present with no dye visible except in one small area below the twelfth rib. A small amount of dye was seen in the lower end of the left ureter (Fig 5). The urine was essentially normal. The blood count showed a marked secondary anemia. A leukocytosis of about 20,000 was present, with an increase in neutrophils to 70 per cent. Phenolsulphonaphthalein excretion was 60 per cent in two hours, 40 per cent of which was excreted in the first hour. A diagnosis was made of a malignant tumor of the kidney, probably of the embryonic type. X-ray deep therapy was started on Feb 23, 1933, 50 r (in air) were applied to the anterior and posterior left kidney areas on six successive days, and saturation twice at intervals of ten days, giving a total of 600 r (in air) over anterior and posterior fields. In April the tumor had decreased to about one-fourth of the original size. At the return in May, the tumor appeared to be larger again, and while physical examination of the chest seemed negative and there were no symptoms, roentgenograms showed definite metastases. The patient died on May 28, 1933, no autopsy being performed.

Case 6 Y. H., X-ray No 3585, female, age 2 years, was admitted to the Wisconsin General Hospital, Section on Pediatrics (Dr J. E. Gonce), on Dec 20, 1933. In the latter part of August, 1933, the parents noted a growth in the abdomen producing a bulging in the region of the stomach. The tumor increased in size very rapidly. Vomiting after meals began; the appetite decreased and the child gradually became weaker. In September, 1933, the right kidney tumor was removed at a hospital in La Crosse, Wisconsin, and diagnosed sarcoma. The tumor weighed two pounds.

Histologic Findings—The tumor cells



Fig 6 Case 6 Photomicrogram of tumor removed at operation. No preceding x-ray therapy (220 X). For description see text.

for the most part resemble those of a large spindle-celled sarcoma, but here and there are groups which present an appearance which suggests that they may at one time have formed tubules. In some areas vacuolated cells (fat cells?) are seen, presumably the result of the invasion of fat tissue by the neoplasm (Fig 6). The kidney tissue itself has undergone extreme fibrosis, with corresponding atrophy of the parenchyma. The tubules are everywhere dilated, with a very low cuboidal epithelial lining. In the cortex they contain hyaline material and sometimes a few leukocytes, while in the medulla they stand open and apparently empty. In the glomeruli there is great shrinkage of the capillary tuft, with pyknosis of the endothelial nuclei and thickening of the capillary basement membrane. The conclusion is drawn that this is a mixed tumor (adenosarcoma).

Following the operation the child's appetite improved and she gained in weight. However, in November she became irritable and complained of pain in the stomach. A recurrence could be felt on the right side of the abdomen about the size of an apple.

Physical examination showed a poorly nourished rather pale female child who

weighed 28 pounds. Examination of the abdomen revealed a definite bulge on the right, palpation disclosed a very large, firm, irregular, non-tender, and non-pulsating mass which extended medially well past the mid-line, upward to the costal margin, and below to the iliac crest. Physical examination was otherwise essentially negative. Urinalysis showed no pathology. The hemoglobin was only 50 per cent, with 4,500,000 red blood cells and 10,000 leukocytes. X-ray examination of the chest showed no evidence of metastases.

X-ray therapy was started on Dec 21, 1933. Within one week, a total dose of 500 r was given over the anterior and posterior right kidney areas. The general condition of the patient, however, remained poor. In February there was marked cachexia and the tumor had increased in size. Another series of treatments was given at that time. The child complained of severe pain in the right upper quadrant, which was relieved completely by irradiation. Roentgenograms of the chest taken on Feb 20, 1934, revealed definite metastases in the lungs. The patient died on March 6, 1934. No autopsy was permitted.

DISCUSSION

An analysis of our six cases impresses us above all with one fact, and that is the high malignancy of these neoplasms. Operation alone or in combination with irradiation seems ineffectual in eradicating the disease. A striking temporary improvement is followed soon by either a local recurrence or widespread metastases leading to death. According to our experience, the lungs seem to be the most frequent site of secondary involvement.

Another observation worthy of mention is the fact that a tumor may almost completely disappear following roentgen therapy, so that palpation cannot definitely outline any mass in the kidney area. Yet, laparotomy often reveals a fairly large residual tumor. In our experience pre-

operative irradiation did in no way complicate the surgical procedure.

It was most surprising to find that the only surviving patient (Case 3) had received only roentgen therapy, no removal of the tumor or nephrectomy was carried out at operation. We are unable to explain this fact, and refuse to draw the obvious conclusion. We are still inclined to believe that pre-operative irradiation and removal of the residual neoplasm, followed by post-operative irradiation, is the most logical method of treatment.

Another interesting phenomenon in this patient was the preservation of the kidney function on the irradiated side as proved by the intravenous pyelogram. While it is well known that heavy doses of roentgen rays produce severe injury to the kidney (Hartman, Bolliger, and Doub, 8) apparently the total dose administered in our case was not sufficiently high to impair secretion. Our material does not permit any conclusions as to the relations between radiosensitivity, prognosis, and histologic picture. One may safely assume, however, that tumors consisting of young and undifferentiated cells will respond quickly to irradiation but are also most apt to recur soon. There seems little hope of improving the prognosis at present since early diagnosis is extremely difficult because of the absence of characteristic symptoms, an observation made in all cases reported by us.

SUMMARY

1 Six cases of kidney tumors in children are reported, in three instances histologic studies of the neoplasm were available. Their pathology, diagnosis, and treatment are discussed.

2 The treatment consisted of operation and roentgen therapy. Five patients died from the disease within two years after the diagnosis was made. One patient, who received only roentgen therapy, is still well and without demonstrable metastases three years and eight months following treatment.

3 In our opinion the most logical treat-

ment is pre-operative irradiation followed by surgical removal of the residual mass if possible and roentgen therapy post-operatively. The optimal time of operation should be determined in each individual case, we cannot advocate any specific period.

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DISCUSSION FOLLOWING SYMPOSIUM ON UROLOGY

DR B. H. NICHOLS (Cleveland). It has been our object, in preparing this program, to try to bring to you a cross-section of the present status of the relation of radiology to urology, both in diagnosis and therapy, and we will proceed with the program.

DR E. A. POHLE (*closing*). In closing, may I urge you to be very reluctant in refusing treatment to any of these children who come to you with these highly malignant kidney neoplasms, even if the patient is not in what we call good condition for irradiation. It is impossible to predict which one of those will respond and give you as satisfactory a result as this one patient of ours who is living now nearly four years after we started therapy.

DR RUSSELL A. HYNESSEY (Memphis, Tenn.). I consider it a privilege to discuss some of the urologic problems of the roentgenologist, for I know of no one upon whom the urologist is more dependent in modern urologic diagnosis. He is to be sure the urologist's most dependable ally. It is true, however, that he will often see conditions which are most disconcerting

and require a most careful urologic investigation to deny.

I prefer to discuss the value of intravenous urography, particularly as it applies in the recognition of obscure urologic anomalies. It is well known, of course, that the kidney which is functionless from any cause will not concentrate the intravenous urographic medium. By the use of intravenous urography, it has been possible to delineate or infer such congenital defects as fusion anomalies, renal hypoplasia, renal aplasia, and congenital absence of one kidney, conditions which were previously not possible of demonstration by cystoscopy or other diagnostic methods than surgical exploration. In four instances, we have been able by its use to imply the congenital absence of one kidney. The lack of concentration of one area furnishes only relative information, however, and it is only by the correlation of clinical findings that such inference may be proved.

Associated genital defects, occurring in 70 per cent of such cases, is the next most important clinical finding to make such diagnosis possible. We have been able to show the value of intravenous urography in these cases by proving the congenital absence of one kidney or a renal hypoplasia by subsequent surgical exploration in four of six cases we have seen.

A hypoplastic kidney may be capable of sufficient function to furnish a clear enough pyelogram to make diagnosis possible. The inability of the aplastic kidney to concentrate or excrete places it, so far as intravenous urography is applicable, in the class of the agenetic kidney.

Freely acknowledging the value of intravenous urography in urologic diagnosis, we have found, nevertheless, that it does not entirely supplant retrograde urography, particularly in detecting early pelvic changes produced by tumors of the renal parenchyma or kidney pelvis, or early renal tuberculosis. It is conceivable that further refinements in its chemical make-up and further experience in its usage will broaden the scope of its application and diagnostic value.

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DR GEORGE LIVERMORE (Memphis, Tenn) I deem it a privilege to appear before this body, for, as Dr Hennessey has so ably stated, we depend upon you so much for our diagnosis in urologic conditions

Excretion urography is not only a great help but it fills a long-felt want in bringing out details that we have been unable to obtain by means of retrograde pyelography. On the other hand, retrograde pyelography brings out details that we cannot obtain by intravenous urography

As the first essayist stated, we know that the reaction following cystoscopy is at times not very pleasant. However, there are many cases in which a diagnosis is impossible without retrograde pyelography, and I think the first speaker was perhaps a little too dogmatic in his statements, because if it goes out generally that a diagnosis can be made so easily by intravenous urography, I am sure it will result in causing a great many very bad diagnostic errors

I think that excretion urography replaces a long-felt want but in no sense displaces retrograde catheterization, the fact, too, that we can always tell the condition of the two kidneys from a functional standpoint, and also obtain the urine from each kidney for microscopic examination and culture makes retrograde pyelography more valuable than intravenous

Kidney function has been said to be demonstrated by intravenous urography, but this is not always true. We have recently had a case in the hospital in which no pyelogram was shown of the left kidney and no outline of the pelvis or ureter at all could be seen, and yet the right pelvis and ureter were clearly demonstrable

On retrograde catheterization, however, the function by PSP of the left kidney was 15 per cent in fifteen minutes, and 10 per cent of the right kidney, therefore, in this case it certainly did not demonstrate the function of left kidney

I have found diodrast by far the best preparation for intravenous urography. Children are subject to the same urologic problems that affect the adult with the ex-

ception of hypertrophy of the prostate and pyelonephritis of pregnancy. In ureteral valves and hypertrophy of the verumontanum, however, we frequently have the same character of obstruction that occurs in hypertrophy of the prostate

In the case of a boy, six years of age, who came to me for hematuria, a pyelogram was made simply by filling the bladder with the pyelographic medium and putting the child up in the Trendelenburg position. It shows a large hydronephrosis, with a dilated and tortuous ureter on both sides. This was the result of a valve in the ureter and a fibrosis of the bladder neck, causing obstruction and back pressure exactly as it occurs in hypertrophy of the prostate. By opening up this child's bladder, cutting the valve, and removing a wedge-shaped piece from the neck of the bladder, he was entirely relieved. He is now twelve years of age, goes to school every day, and is apparently well

Children can be cystoscoped with the same degree of accuracy and the same degree of precision as in the adult and with far less reaction

In the case of a boy baby, eleven months old, whom we cystoscoped recently, the film shows the catheter in the right ureter going away over to the left side. This made me suspect that he had one of those anomalous, ptosed kidneys or a congenital single kidney with two ureters. When we made the pyelogram, however, the catheter was in the pelvis of the left kidney with practically a normal pelvis on that side, whereas on the right side, the catheter is drawn away over to the left on account of the extreme dilatation and tortuosity of that ureter. The patient was relieved by nephrectomy

I mention another case of a boy baby, eleven months old. The catheter was seen to be coiled up inside the hydronephrotic sac and only the upper portion of it filled. This child had practically no urinary symptoms except an occasional pus cell in the urine. He had been running a little temperature when he had pus, when the pus cleared up, the temperature would subside

He had been treated for pyelonephritis since he was two months old. He was cured by nephrectomy.

It is very easy to catheterize children if they are under an anesthetic. There is only one contra-indication to cystoscopy in children and that is a high blood urea and creatinin and a very low P S P output. We have small cystoscopes designed by many different urologists, so that sex and age are now no bar to cystoscopy in children. I have cystoscoped and pyelogrammed a baby three days old.

DR A E JONES (*closing*) I will answer my friend and colleague, Dr Livermore, by saying that perhaps I was a little bit too

dogmatic, and asking him to take into account the title of my paper "The Superiority of Intravenous Urography over the Retrograde Method in Certain Well-defined Cases." I tried to confine myself to those cases in proving my point.

As far as Wilms' tumor is concerned, I enjoyed that presentation very much because we had a chance of seeing four of these cases in the last year, and, by the way, the patients are all dead—I don't know whether or not the radiation produced metastasis. It certainly does shrink the tumor, but there are some men who earnestly believe that it has something to do with producing metastasis.

THE IMPORTANCE OF ROENTGEN GASTRIC FUNCTIONAL STUDY IN THE DIFFERENTIAL DIAGNOSIS OF PYLORIC LESIONS¹

By PROFESSOR WILLIAM H MEYER, M D, *New York City*

From the Department of Radiology, New York Post-graduate Medical School of Columbia University

PRELIMINARY

BEFORE proceeding with a discussion of the material at hand I should like to present ten illustrations selected from the 101 cases in which operation and biopsy follow-up were obtained, and ask you to tax your imaginations and personal diagnostic abilities before noting the pathologic conclusions

FIGURE 1

The odd case in Figure 1, labeled No 101 (not one of the pyloric series), which is obviously a neoplastic invasion of the pars cardia, was that of a young girl, aged 16 years. The pathologic interpretation is that of a *congenital mesenchymatous tumor*

Case 2 (Fig 1), which shows extensive neoplastic invasion of the pars pylorica, is pathologically reported as a *Krukenberg tumor and metastatic carcinoma of the ovary*

Case 3 (Fig 1), which in its radiologic aspect is somewhat similar to Case 2, is pathologically labeled *lymphoblastoma* (probable Hodgkin's disease)

Case 4 (Fig 1) shows extensive gastric wall infiltration with several niches. The pathologic report is that of *primary sarcoma* with multiple ulceration

FIGURE 2

The similarity of the location and character of lesions (Fig 2, Cases 5 to 10) are obvious. However, in Case 5, the defect at the pylorus is evident, because of the functional behavior the lesion was radiologically interpreted as probably not malignant but rather as a papilloma with partial hypertrophic stenosis. Surgically and pathologically the lesion is reported as

invagination of *hypertrophic mucous membrane fold*

(Fig 2, Case 6). Notwithstanding the rather wide defect at the pylorus, the atony, dilatation, marked and prolonged retention, hypomotility and irregular peristaltic action suggested *hypertrophic pyloric stenosis* from an old ulcer, and the lesion was so interpreted. This was surgically and pathologically confirmed.

In Case 7 (Fig 2), the radiologic examination suggested probable malignancy. It was because of the gastric shrinkage and other strongly supporting functional changes that this interpretation was made. Following resection, the pathologic conclusion is that of *malignant ulcer*. However, in the detailed description the pathologist observes an extensive lymphocytic infiltration of undetermined character (the case is still under observation).

In Case 8 (Fig 2), the patient was a male, 30 years of age, in good physical condition but with the history of a possible chancre. Furthermore, because of the functional behavior and character of the pyloric defect, a roentgen interpretation of probable syphilitic hypertrophic pyloric infiltration was made. Microscopic examination of the resected pylorus showed *miliary nodular infiltration with tuberculous ulcer*.

Case 9 (Fig 2) was both clinically and radiologically quite similar to Case 8 (Wassermann negative). A similar roentgen interpretation of hypertrophic pyloric infiltration was made. The pathologic report indicates *syphilitic hypertrophy and ulcer*.

Case 10 (Fig 2) is of interest mainly from the clinical standpoint. The patient was a well nourished young man, 35 years of age, in good physical condition except for recent moderate gastric distress. The

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis Tenn. Dec 3-7 1934.



Fig 1 Cases 1, 2, 3 and 4

physical examination was negative except for a slight anemia. Notwithstanding the roentgen interpretation of malignant pyloric infiltration, the medical department insisted on a course of treatment on a clinical diagnosis of benign ulcer, not so much because of the positive roentgen diagnosis, but mainly since the case was primarily that from a surgeon. A subtotal gastrectomy for pyloric carcinoma ensued and this was pathologically confirmed. There

was no evidence of metastasis at the time of operation. The patient was readmitted three months later at which time he died of extensive pulmonary metastasis.

Morphologically, the radiologic uncertainties of true histopathology approximates 10 per cent. A correct interpretation differentiating benign from malignant lesions is made in nine out of ten cases. Yet in 100 cases, holding the same proportions 40 uncertainties are a

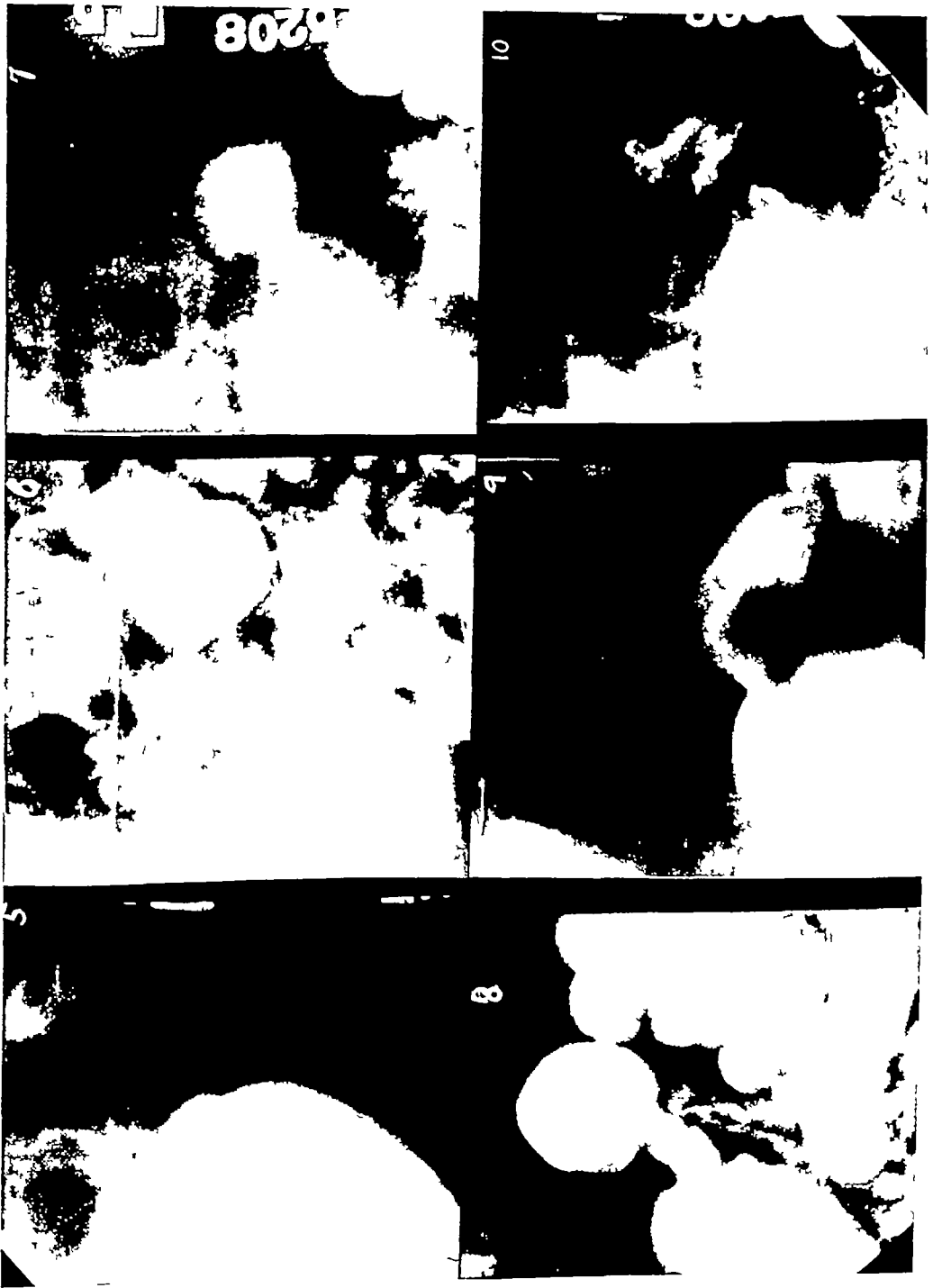


Fig 2 Cases 5 6 7 8 9 and 10

formidable array, and challenge to greater effort in differential diagnosis. Needless to say here, and to you, that the 90 out of a 100 cases in which an interpretation is correct fail to outweigh the criticism

of only one in which you were not letter-perfect

Subject—My subject is more in the form of a question, resulting from certain

radiologic observations in a series of pathologically proven cases, rather than a criticism of any present methods or the presentation of anything startling or new

Basis—As a basis for our investigation, we have reviewed our files and follow-up records in approximately 5,000 roentgen gastric examinations, of which almost 8 per cent were reported as showing definite intrinsic lesions. Of these, we have selected 100 consecutive cases of lesions at or near the pylorus in which either a follow-up through operation, or a pathologic study by biopsy or autopsy was obtainable. This means a successful follow-up in about 25 per cent of the cases.

In the remaining 300 cases, the operative data without biopsy but inclusive of the clinical follow-up would appear sufficient verification of the radiologic conclusions. These would have a definite bearing upon any statistical summation but should not be included where strict pathologic data are required.

Discussion—In recent years, perhaps because of the apparent greater certitude thereby afforded, and because of the general interest given the subject by many publications, the direct method of visualization of gastric lesions and demonstration of mucous membrane defects appears to have taken precedent over the study of gastric functional disturbance, or the so-called symptom complex method of interpretation, so ably employed by the early workers in this field.

There is no gain saying the fact that a film record showing a so-called characteristic defect affords most convincing evidence of a lesion. It is also apparent that some of the newer methods are but revivals or modifications of the morphologic and roentgen studies as previously accomplished with sedimentation mixtures, pastes, etc., wherein there is much redescription of mucous membrane dimpling, distortion, and obliteration along with the running of the Haudick melle of old.

It is not my intent in the least to detract from the value of the direct method of interpretation since such study when fol-

lowed by operation and biopsy supplies most valuable information as to the type, origin, and extent of any given lesion. On the other hand, it is well for the roentgenologist to keep in mind that at the present stage of the development of roentgenology there is as yet no direct means to radiologically determine color, consistency, cell types, or organisms, and, therefore, any attempted histologic interpretation is but a surmise based upon gross appearance and statistical average.

Again, the early carcinoma and the several other types of neoplastic disease, such as the small malignant ulcer, the granulating, florid, flat, shallow ulcers, and certain hemorrhagic cases, still offer interpretative difficulties to any radiologic procedure. In many of the cases of partial obstruction, the secondary changes tend to obscure the primary cause of the lesion and render direct visualization difficult. It is in such cases as these that the roentgen study of gastric dysfunction appears to us of paramount importance and affords much supportive information in the more difficult realm of differential diagnosis.

The more important and closely interrelated indirect roentgen data would appear to be as follows:

(1) Transitional changes in size, shape, position, and mobility of the stomach in reference to age, sex, and status.

(2) Gastric tonus, antral and pyloric action.

(3) Peristaltic activity, that is, the origin, depth, frequency, and asymmetry of action, as well as contractions and spasm.

(4) Evacuation and motility.

(5) Abnormal stasis, retention, and hypersecretion.

(6) Rugae variations—organic or not.

(7) Morphologic defects differentiating artifacts, spasm, and those of extrinsic origin.

It might be well for us here to observe that not one of these data can stand alone, no more than any single symptomatic observation at the bedside is absolutely

TABLE 1—IMPORTANT RÖNTGEN DATA OBSERVED IN 100 CONSECUTIVE OPERATIVE CASES OF PYLORIC LESIONS¹

Pathologic diagnosis	No cases	Shape	Size	Tone	Peristalsis	Retention	Motility	Defect
Stenosing post pyloric ulcer	31	Tendency hypertonic	Average normal	Active	Hyperactive	Medium large	Tendency hyper	Niche Imperfection 14 17
Stenosing pre pyloric ulcer	9	Hypotonic	Large	Poor	Periodically active and quiescent	Large crescentic	Hypo	Niche Tapering 2 7
Papilloma and/or memb hypertrophy	3	Average normal	Medium	Active	Fair	Medium	Average normal	Gap defect 3
Syphilitic infiltration	1	Hypertonic	Medium small	Active	Fair	Medium small	Hyper	Annular constriction
Tuberculous infiltration	1	Orthotonic	Average normal	Active	Fair	Medium small	Hyper	Annular constriction
Adhesions bands	5	Average normal	Average normal	Active	Average normal	Medium small	Normal to hypo	Variable constriction 5
Adenocarcinoma	32	Ortho to hypertonic	Medium small	(Rigid)	Diminished to <i>absent</i>	Medium oval	Tendency hyper	Nodular defect 29 Constriction 3
Sclerous carcinoma	11	Tendency hypertonic	Medium small	(Contract)	Diminished to <i>absent</i>	Small linear	Tendency hyper	Rigidity and constriction 11
Malignant ulcer	4	Hypertonic	Medium	Active	Diminished	Medium oval	Normal to hypo	Niche Tapering 3 1
Sarcoma	2	Hypertonic	Small	Active	Diminished	Medium small streak	Hypo	Nodular Niches 1 1
Lymphoblastoma	1	Orthotonic	Medium	Active	Absent	Medium	Hyper	Nodular defect

¹ In this table the cases have been grouped according to the pathologic findings with a summary of the essential functional aberrations observed. It should be noted that this table represents but one fourth of the total number wherein radiologic interpretation appeared conclusive. However cases with insufficient micro-pathologic confirmation are not here listed.

characteristic. It is by the study and correlation of the symptom-complex as a whole that the true character of a given pathologic process may be revealed.

A statistical survey of our work would suggest that, if we adhere strictly to the operative cases with biopsy-autopsy confirmation, then we gain the impression that fully 50 per cent of all pyloric lesions are of a malignant nature. This, however, is due to the greater frequency with which operative procedure is instituted in the more serious cases.

If, on the other hand, all of the cases of pyloric pathology, radiologically determined (almost 400 in number covered by this period of investigation), are included, then only 25 per cent are recorded as malignant. In these there has been a sufficient time lapse with clinical follow-up or operation to justify this conclusion.

It is also evident that radiation therapy is not receiving proper consideration. I am convinced from experience that some of these patients would still be alive if proper radiation therapy had been used either pre- or post-operatively or without any operation (other than biopsy confirmation). These include at least the cases of congenital embryonal tumors, the lymphoblastomas (Hodgkin's disease), and lymphosarcomas.

SUMMARY

In summarizing, the following conclusions would appear justifiable:

1 The benign irritative lesion is responsible for a train of symptoms, such as (a) hypertonus, (b) hypersecretion, (c) peristaltic hyperactivity, and (d) spasm, with (e) resultant disturbance in motility.

2 In the benign pyloric obstructive lesion the complex is most impressive. The observed data are as follows: (a) delayed evacuation with marked hypomotility and pronounced gastric retention, (b) atony and dilatation (from gastric wall atrophy), (c) long periods of quiescence, alternating with periodic peristaltic hyperactivity. (The primary cause most frequently is callous ulcer.)

3 Again, how clearly the partial post-pyloric obstructive lesion can be defined if one will but observe that (a) with gastric hypertrophy the tonus is preserved, if not exaggerated, (b) the peristaltic hyperactivity is especially prominent in the pylorus with antral distention, (c) notwithstanding a fair sized gastric residue continuing well beyond the normal time limit a colonic hypermotility frequently exists.

Truly it must be apparent that by the observance of such symptomatology a differentiation between the benign pre- and post-pyloric lesions can well be established. One not infrequently meets a lesion wherein the morphologic study leaves one in doubt as to its benign or malignant character. Here again will the observance of the indirect data often afford the necessary information for differentiation.

4 Faced with a lesion in an obstructive location the following are convincing observations of the malignant character of the process: (a) the gastric shrinkage, *i.e.*, the luminal contraction, (b) the wall rigidity, (c) the lack of peristaltic activity over the infiltrative area, (d) the patency with (f) a paradoxical hypermotility.

5 When with the usual contrast meal a definite morphologic defect is discernible, then may a systematic functional study aid in determining the degree of irritation, obstruction, or disturbed motility caused by the lesion, as well as afford greater refinement in differential diagnosis.

A detail rugæ study would, under these conditions, appear superfluous since, frankly, most of the reproductions of rugæ defects are only corroborative of previously suspected or morphologically proven lesions.

6 When functional disturbances of undetermined origin are observed wherein the causative factor is morphologically not revealed but the stomach is none the less under suspicion, then the greater detail afforded by the rugæ study would justify the additional time, energy, and expense of this procedure. On the other hand, it is also well to remember that every gastric

upset is not necessarily indicative of ulcer, carcinoma, or other serious organic diseases

Acknowledgment is hereby made of my indebtedness to all the associates in the Department of Roentgenology for their

assistance in compiling the data. Special mention to Dr Debbie, Dr Furst, and Dr Kurtz, for their perseverance in obtaining follow-up data, and to Dr Schleier for his diligence in compiling and tabulating the cases

THE SOCIAL AND ECONOMIC ASPECTS OF CANCER¹

By ALBERT SOILAND, M D , D M R E (Camb), *Los Angeles, California*

LOOKING at the cancer problem in America, from both an economic and a social viewpoint, based on intimate contact with patients for over a quarter of a century, I am convinced that a determined effort at mass education is necessary if we are ever to gain the upper hand of this dread disease. By mass education I mean a serious attempt to arouse public interest, not by intimidation or force of arms, but by an earnest appeal to reason—establishing an intelligent and sympathetic understanding to which every interested individual may subscribe and work in a spirit of united harmony.

Before undertaking any comprehensive public campaign, the medical profession itself should become more cancer-minded. It is true that in the larger medical centers an increasingly greater number of surgeons, radiologists, pathologists, and other cancer students are working consistently and faithfully to this end, but a surprisingly large majority among the members of the regular medical profession seems either apathetic or but casually interested. Unless this latter group can be aroused, our task with the public will be rendered doubly difficult.

The general practitioner or the family physician is often too prone to advise his patient to ignore certain pathologic conditions of the skin, such as warts, moles, papillomas, or other irregularities, because they are symptomless. This is nothing more nor less than pure carelessness, and is usually due to the fact that the physician has not become cancer-minded, thus permitting many a potential cancer case to rest secure in this ill advice until the little lesion referred to has become fixed, or metastasized or even hopeless.

It is not that this physician is unfamiliar

with cancer, but the subject has not been sufficiently stressed for him to realize just how important his position is, for he stands in the first line of defense and offense against the insidious enemy, cancer. This general practitioner or family doctor should be contacted through his local medical societies and made thoroughly aware of his own important position and function in our world-wide cancer program. He should be made to realize that at the present time practically 10 per cent of the American population dies from cancer—an appalling increase during the past three decades, and also that this death rate can be materially reduced by an intelligent co-ordination of the knowledge now available.

It is singularly strange that our own nation, the United States of America, has failed to appreciate the social and economic phases of the cancer problem. We surely spend enormous sums to combat hog cholera, tuberculous cattle, infected poultry, and mangy dogs, but not one governmental penny to prevent a human being dying from cancer.

Let us briefly glance through and epitomize what twenty-seven foreign nations are doing at the present moment to fight humanity's most relentless enemy. This symposium was held under the auspices of the Fourth International Congress of Radiology at Zurich, Switzerland, the last week of July 1934. The meeting took place in the Stadteater and was open to the public under the heading "Organized to Fight Cancer," and in the following order of nations.

Sweden (Prof. Gösta Forssell)—The fight against cancer is under government control. King Gustav donated 5 000,000 kronor for the purchase of radium after public spirited citizens had established a radium home for the treatment of cancer. In that country, co-operation between the government and the medical profession has

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upset is not necessarily indicative of ulcer, carcinoma, or other serious organic diseases

Acknowledgment is hereby made of my indebtedness to all the associates in the Department of Roentgenology for their

assistance in compiling the data. Special mention to Dr Debbie, Dr Furst, and Dr Kurtz, for their perseverance in obtaining follow-up data, and to Dr Schlem for his diligence in compiling and tabulating the cases

cial and economic difficulties have made it very hard for Greece to take on an active anti-cancer campaign. Private parties purchased a little radium for the medical profession. The foundation of a cancer institute is the most important problem facing students of cancerology to-day.

Great Britain (Dr A. B. Smallman) — The best cancer statistics during the past thirty years come from England, where Dr Smallman has presented some very interesting diagnostic figures. It appears that the death rate among males is increasing greatly over that of females during the years mentioned, which this author feels has occurred despite more accurate diagnostic facilities, thus showing that cancer incidence is increasing. He finds that the mortality is falling off in cases in which cancer occurs in organs so accessible and localized that they are amenable to modern treatment. He urges a thorough study of cancer on an organic classification and makes a plea for a grouping of large numbers of individual cases for this purpose. This calls for a centralization and co-ordination of clinical statistical studies of cancer incidence.

Ireland (Dr Oliver Chance) — Here the cancer fight is just beginning. Tuberculosis has been a big problem but is now under control, so the medical authorities are turning to the cancer problem. Radium emanation is available at a nominal charge, and education among the Irish people is carried on through the general medical profession.

Italy (Prof G. G. Palmieri) — In 1922 Italy began to fight cancer in earnest with the foundation of the Italian Anti-Cancer Federation, and in 1929 the Cancer Institute Victor Emanuel III was inaugurated. For a number of years, however, the national Fascist government has supplied financial help, and a large institute was founded in Rome. At the present time there are a number of important cancer research and treatment centers, the social side of which are being actively developed by the government. The country has nine grains

of radium and all institutions are equipped with short wave x-ray equipment.

Japan (Prof T. Watanabe) — This country has a foundation for cancer research, established in 1907, to stimulate interest and furnish funds for students interested in cancerology. A large institute in Tokio is devoted to the clinical and laboratory investigation of cancer. A council of the Cancer Foundation is disseminating knowledge and carrying on active propaganda throughout all Japan, and the medical personnel of the Foundation believes Japan will soon become cancer-minded.

Jugoslavia (Dr S. Tassovatz) — The Jugoslavian Society for Cancer was founded in 1927, and is active in cancer research and treatment. There are no special cancer institutes but the medical profession is carrying on cancer education among the laity. Belgrade and Zagreb are the only two towns with radium. The Jugoslavian Society is immediately concerned with the creation of a cancer institute where research and treatment can be prosecuted.

New Zealand (Dr Charles F. De Monchaux) — The British Empire Cancer Campaign Society has a branch in New Zealand. Funds were raised by public subscription and netted £70,000. There are four central divisions where cancer work is institutionalized. Weekly clinics are held, headed by two surgeons, one pathologist, and two radiologists, other specialists being called in for consultation when necessary. Radium is employed, limited strictly to those who are qualified by training and experience to use it. The work of the four divisions is registered and tabulated by a central special official. Cancer education to practitioners and students emanates from the centers. The Society itself maintains facilities for research in cancerology. It has available a special travelling radio-physicist who standardizes all radiation equipment.

Netherlands (Dr Daniel den Hoed) — In Holland the cancer campaign is limited to a study of the disease and the education of the public, as the treatment of patients is not centralized. There is a private cancer clinic in Amsterdam supported by the

demonstrated its value to the point that Sweden ranks perhaps first among the world's nations where cancer is practically under an intelligent control

Egypt (Dr M A Afifi) —Here cancer is considered as part of the general health problem of the land, and the government is assisting in equipping suitable hospitals with x-ray and radium facilities. Due to the thorough religious cleanliness of the Mohammedan race, which constitutes a large part of Egypt's population, the death rate from cancer is considerably lower than in more industrialized nations

United States of America (Dr Albert Soiland) —The government has so far taken no official steps to combat cancer. Several state medical associations have cancer commissions. A number of surgical and medical bodies have cancer committees and many of the larger hospitals have cancer clinics. There is an endowed American Society for the Control of Cancer, and a number of universities have cancer research departments. Much experimental work is under way with super-high voltage x-ray apparatus, the first one emanating from the California Institute of Technology in 1928, under the direction of Professor R A Millikan and Dr Charles C Lauritsen

Austria (Prof G Schwarz) —In 1911 was founded the Austrian Society for the Investigation and Treatment of Cancer, and is to-day the central organization in the campaign against cancer. Rather meager funds are obtained from private sources. The Society sends out information to the profession and also advises the laity to seek diagnosis and treatment from physicians and not quacks. Cancer treatment is given at university clinics, and large general hospitals, by staff specialists. The Vienna General Hospital, founded in 1912, has over a gram of radium, provided by public funds. In 1930 a new radium institute was founded in Vienna and provided with five grams of radium

Dr H M Moran makes a plea for a more frequent and intelligent use of radiation therapy in cancer. He summarizes his suggestions for cancer control under the

following heads: Prophylaxis, post-graduate medical education, coordination of treatment and, in particular, the limitation of the right to employ radiotherapy to those trained and qualified to use it, and, finally, a more extensive and more friendly co-operation between the surgeon and the radiologist

Belgium (Prof Joseph Maisin) —Has a national cancer commission appointed by the government, which consists of specialists in cancerology. It controls the subsidies granted to the various cancer-treating organizations. There are four cancer-treatment centers supported by the government, where an abundant supply of radium is available. Like Sweden, Belgium has an enviable position and is well "organized to fight cancer"

Denmark (Dr Jens Juul) —Has no special cancer hospitals. The government contributes a little money, insurance companies and private individuals more. There are three cancer centers where radium is available and the surgeon and radiologist have charge of the work. Denmark is making good progress in the cancer campaign

Germany (Dr Kurt Weiss) —After intermittent attempts to organize a cancer commission in 1910, a new committee was formed in 1930 to organize measures for the fight against cancer as a disease of the people. The committee is subsidized by the constituent states of the Reich. There are eight German centers for the diagnosis and care of cancer patients

France (Dr R Ledoux-Lebard) —This country was early to recognize the necessity for cancer study and control. Like Sweden and Belgium, it recognized the necessity of studying the social side of the problem as well as the economic, since the incidence of cancer in France is well marked. There are a number of well organized and equipped leagues, institutions, and hospital groups where the highest type of surgical and radiological treatment is available. Dr Ledoux-Lebard feels that his country is incomparably complete in its fight against cancer

Greece (Dr A Lambadaridès) —Finan-

Tchecoslovakia (Dr Anton Ostrčil) — This country's Society against Cancer was founded in 1904 with the following program (1) Scientific study of cancer, (2) early diagnosis, (3) treatment, (4) public instruction. The most important institute is in Prague. Four or five others are being modernized. This little country has already twenty-four grams of radium in use and is adding three grams yearly.

Hungary (Dr Ivan Von Buben) — During recent years the death rate from cancer has definitely increased. Systematic fighting against cancer began in 1900, with the Cancer Commission of the Royal Medical Association compiling cancer statistics. The Great War stifled cancer research but now it is being prosecuted with greater vigor. The general hospitals and allied institutes are doing cancer research and treatment, and the Cancer Commission is co-ordinating this work.

In summing up the cancer program of these twenty-seven progressive nations, it is significant to note that they are all engaged in practically the same line of endeavor. This is quite in harmony with the viewpoints of advanced American cancer students and resembles our own conception of proper progress. If a commission of representative medical men will establish a central bureau, America would acquire a leading position in this necessary world's under-

taking. If I may be permitted to suggest a supervisory system, it would be something like the following:

- 1 Organize a central bureau of cancer study and research.

- 2 Establish cancer branches in all accredited universities, hospitals, and clinics where adequate facilities for such work exist.

- 3 Permit no one not qualified by training and experience to use radium or x-rays for the treatment of cancer, and then only after consultation with specified authorities.

- 4 Sell or rent radium only to such experienced operators as noted under paragraph 3.

- 5 Allow no surgical operation for cancer unless approved by specified authorities after consultation.

- 6 Every potential cancer patient should have the benefit of a complete clinical examination and consultation between internist, surgeon, and radiologist, and pathologist before treatment is instituted.

- 7 Copies of the records of every cancer patient should be sent to the central bureau for compilation and that statistical progress may be noted.

- 8 Such a régime would, before very long, do away with cancer exploitation and abuse, and place America in the first rank of nations "organized to fight cancer."

medical profession and private individuals, to which the government also subscribes. This is a modern institution, fully equipped. Research work is carried out, volunteers are trained in cancerology, and prizes are awarded for meritorious work.

Norway (Prof S A Heyerdahl) —The Norwegian Medical Association studied 25,000 deaths from cancer, and came to the conclusion that a certain family liability or heredity was a basic factor. This work began in 1907. In 1919 the government advanced 1,000,000 kroner for a national cancer hospital, which had been suggested by the Central Committee of the Medical Association. Thus, the Norwegian Radium Hospital was opened in 1932. It is quite complete with all modern appliances, and has three grams of radium. Its director is a radiologist.

Persia (Dr Mohammad Khan Hesaby) —The country recently organized an anti-cancer campaign supported by His Majesty Reza Shah Pehlevi, who yearly donates a respectable sum. A central radiological institute has been established, furnished with all modern apparatus except radium, which will soon be added.

Poland (Dr Zygmunt Stankiewicz) —The Polish Anti-cancer Campaign Committee was founded in 1921, although intermittent studies had been under way since 1906. The anti-cancer center is in Warsaw and its efforts are directed toward securing funds for a radium institute, as its present amount of radium is inadequate. New centers are in the process of completion at Lodz, Poznan, Vilno, and Lwow. Propaganda is active both among the profession and laity, and these activities are developing rapidly.

Portugal (Prof Mark Athias) —In 1927 the Portuguese Institute for Cancer Research came into being. It is attached to the University in Lisbon and supported financially by the state, the insurance societies, and the medical faculty. There are three departments—x-ray, radium, and a clinical division. Indigents are treated free of charge. The work is being publicized and attempts are under way to equip

similar institutes in the other university cities.

Russia (Prof G O Charmandarjan) —The Peoples Commissary for Russian Health Affairs, among other duties, directs the cancer campaign. The system appears somewhat complicated, but plans contemplate a scientific investigation of the cancer problem with education of specialists and teachers. It is aimed to found hospitals, create post-graduate courses, where diagnosis and statistics of cancer may be arranged and where care may be taken of incurable cases.

Switzerland (Prof Alfred Rosselet) —The Swiss National League against Cancer became active in 1910 under the direction of the Health Department, its first object being to support scientific research and organize meetings for public education. It is now attempting to co-ordinate the various centers. The government is unable to provide for a central organization, so each state arranges its own cancer work. The various regional hospitals and university clinics take care of cancer patients. Private funds are sought for the purchase of radium.

Spain (Prof Carlos Gil Gil) —In 1919 the National Anti-cancer Society was founded. The Anti-cancer League was formed in 1923 with support from the state, which is now carrying on a systematic program so that all parts of Spain may enjoy the same facilities for the treatment of cancer patients. Madrid is the center, with its National Cancer Institute fully equipped with all modern weapons to fight cancer. Besides, there are six large cities with regional centers co-operating with one another under the direction of the health authorities. There are also a number of secondary centers which provide a link between the regional centers and the general practitioners.

Tartar Republic (Prof Ruben Gassul) —To the Cancer Institute already established come many patients for treatment in a very advanced state. Cancer departments have been established in all clinics, where consultation is available. Propaganda is under way and statistics are being compiled.

two pieces of toast with four squares of butter, and a glass of half milk and half cream

In some cases of the non-visualized gall bladder, the examination is repeated, particularly when the roentgen findings do not fit into the clinical picture and when there has been some error on the part of the patient in following out the instruction

There are many radiographic technics for the gall-bladder examination, and the end-result in one may be as good as in the other. The technic may often depend upon the capacity of the equipment that one has at his disposal. As a routine it has been found that the best roentgenograms are obtained when the voltage is kept as low as possible. This depends upon the ability and the condition of the patient to co-operate, and not infrequently the voltage factor will have to be increased in order to maintain an exposure time as short as possible.

The x-ray diagnosis of a pathologic gall bladder is dependable up to about 98 per cent, the roentgen diagnosis of a normal gall bladder is dependable up to about 95 per cent in cases in which the management and technics are exacting. However, in some cases the normal cholecystogram is prone to error. It is important, therefore, in certain patients who have a normal cholecystogram to regard these criteria as an adjunct only in the clinical examination and of value only when interpreted in conjunction with the clinical history and physical findings and after all known extra-cystic factors have been excluded.

It is well known that a small percentage of patients having a pathologic gall bladder will reveal a normal cholecystographic series. In order to avoid clinical error in

this group of cases, the normal cholecystographic findings should be evaluated with the clinical history and physical findings, and can be relied upon only when other extra-cystic factors have been excluded, and when the extra-cystic findings account for the symptomatology. Otherwise, a patient with a normal cholecystographic series, in whom other abdominal conditions have been excluded, should be considered to have a pathologic gall bladder if the clinical findings are indicative of such, regardless of the normal cholecystographic series.

The following conditions have been found to be the cause of non-visualization of the gall bladder: hepatitis, cholangitis, duodenal ulcer, achlorhydria, malignancy of the stomach, liver, and pancreas. One must also bear in mind the rare possibility of congenital absence of the gall bladder as well as transposition of the abdominal viscera, in which case the gall bladder would be in the upper left quadrant. It is readily to be seen that errors in cholecystographic interpretation can be reduced to a minimum in conjunction with an examination of the gastro-intestinal tract.

As clinicians practising radiology, we must pay some attention to the differential diagnosis of gall-bladder disease. The following conditions should be considered: duodenal and pyloric ulcer, duodenal stasis, duodenitis, hypo-acidity, viscerotaxis, enlargement of the liver due to passive congestive in decompensated rheumatic heart, diaphragmatic pleurisy, sub-diaphragmatic abscess, hepatic abscess, hydatid cysts of the liver, tertiary syphilis of the liver, pathologic appendix, incomplete intestinal obstruction, carcinoma of

TABLE I—TECHNICAL FACTORS USED IN CHOLECYSTOGRAPHY

Cm (A P) thickness	Pos	Time	A T volts	k V	Ma	Dist	Tube	Fast screen	Bucky	Cone
15	P A	1 5	117	52	100	27	100	Yes	Yes	Yes
20	P A	2 5	117	52	100	27	100	Yes	Yes	Yes
25	P A	3	122	56	100	27	100	Yes	Yes	Yes
25	Lat.	3	137	68	100	27	100	Yes	Yes	Yes

CHOLECYSTOGRAPHIC DIAGNOSIS MANAGEMENT AND TECHNIC FOR ORAL CHOLECYSTOGRAPHY¹

By D S BEILIN, M D , Radiologist, Augustana Hospital, *Chicago*

THE management and technic for oral cholecystography must be well standardized for uniform results, particularly when there are a number of assistants conducting the cholecystographic examinations

The patients are informed explicitly in regard to the nature and routine of the examination, a simple account being given them of its management from beginning to end. After the patient is completely disrobed and attired in a gown which has no buttons, metal fasteners, etc., a preliminary roentgenogram of the gall-bladder region is made to determine the following: whether or not the gall-bladder shadow is visible, the size and position of the right lobe of the liver, the eliciting of opaque calculi if present, the determination of the extent of gas and fecal material within the colon, as well as the location of the hepatic flexure.

The patient is placed prone on the radiographic table which contains a Bucky diaphragm so placed that the right upper quadrant of the patient is at its center, in order that the central rays of the x-ray tube shall pass through the right upper quadrant. Size 10 by 12 cassettes are used and placed so that a portion of the crest of the ilium is visualized on the lower border of the roentgenogram. In the majority of individuals a film of this size will include the gall-bladder area and the right lobe of the liver, down to the crest of the ilium.

If the preliminary roentgenogram reveals a considerable amount of gas and fecal material within the colon, and if there is no contra-indication to a laxative, the patient is instructed to take from one to one and one-half tablespoonful of compound licorice powder at 3 00 P M the day prior to the Graham examination. If a laxative is contra-indicated, the patient is instructed

to take an enema on the evening before the examination as well as at 7 00 A M on the morning of the roentgen examination. On the preceding evening, the patient is given a prescribed supper at 6 00 P M which consists of toast or crackers, baked or boiled potato, raw or cooked fruit, tea or coffee, no fats are given. At 8 00 P M the patient drinks a single dose of the sodium salt tetraiodophenolphthalein which is usually four grams, and in some instances five grams, depending upon the anteroposterior diameter of the abdomen as well as the patient's weight. The patient may have water at frequent intervals and is instructed to have no breakfast whatever.

At 9 00 A M the following morning, the first or thirteen-hour roentgenogram is made. If the gall bladder is obscured by gas or fecal material, the patient is given an enema. At 11 00 A M the fifteen-hour films are made, which include roentgenograms in both the postero-anterior and anteroposterior views. If the gall-bladder shadow is distinctly visualized, and if up to this point the examination is satisfactory, the patient is allowed to eat a meal rich in proteins and fats. At one hour after this meal the patient is requested to return for the seventeen-hour roentgenogram. If, however, the gall-bladder shadow is not distinctly visualized at fifteen hours, the patient may be requested to return at seventeen, nineteen, and not infrequently twenty-one hours without food, in order to study the filling and concentration of the gall bladder and more particularly to conclusively exclude faintly defined radio-translucent calculi. In certain cases, roentgenograms of the gall bladder are made in the upright position, in the oblique and lateral views, and only occasionally with compression.

The meal which is usually given after the fifteen-hour examination consists of dry or cooked cereal with cream, bacon and eggs,

¹ Presented at the clinic of the Radiological Society of North America, at the Twentieth Annual Meeting in Memphis Tenn., Dec 3-7, 1934.

X-RAY STUDY OF THE GASTRIC RUGAE

By WALTER E. PENNINGTON, M.D., Indianapolis, Indiana

WHILE the above subject has been treated and described by numerous men since 1912, yet a review of the literature on this subject shows that each student was confronted with troubles in technic. A great variety of methods have been described, including fluoroscopic studies, numerous types of gastric meals, such as barium suspensions, colloidal solutions, oil suspensions of opaque media, and double contrast methods by means of air or carbon dioxide.



Fig 3



Fig 1



Fig 2

The greatest handicap seemed to be in getting a proper suspension of the barium and then getting rapid films so as to eliminate motion of the stomach peristalsis and motion from the aortic pulsation. The stomach wall must be studied with respect to the rugae before the stomach has been distended or heavily palpated. Either of

the latter procedures will have a tendency to iron out the mucosa folds.

It has been previously demonstrated that the mucous membrane has a distinctive movement of its own action of the muscularis mucosae. Usually after the stomach has been at rest the observer will expect to find normal mucosa folds in a normal

the stomach, carcinoma of the bile ducts, carcinoma of the pancreas, hydronephrosis, pyonephrosis, renal calculi, etc

are carried out, we, as clinicians practising radiology, will find that the errors in cholecystographic diagnoses will be reduced to

If the foregoing principles and methods a minimum



Fig 6



Fig 7

right to say that the folds are of an exact constant formation because they depend on the hypotonicity, hypertonicity, or orthotonicity of the stomach

Visualized folds vary in their depth according to the quantity of barium used in the stomach, the degree of compression, and the amount of manipulation. However, if we do not exaggerate any of the above factors a constant general picture of the rugae will be found in each normal patient.

Some of the following characteristics are to be observed when studying the mucosa folds:

Parallel rugae running from cardia to pylorus, transverse folds which occur in excessive mucous membrane, with subsequent plicating of the longitudinal or parallel folds, irregular folds on the greater curvature which seem to be the result of finer peristaltic movements, stellate folds which seem to have a central scirrhous area, wide

folds which may present light plateau areas or jigsaw puzzle effect, absence of folds.

An observation was made in a patient who was gradually failing because of pyloric obstruction and inability to handle food. The X-ray examination showed a small ulcer crater in the pylorus and a well-defined ulcer in the duodenal cap. Three consecutive stomach examinations showed a very spastic lower third of the stomach, with a constant contraction of the gastric lumen to the size of the thumb. At no time was there any relaxation of the gastric wall. On account of the rigidity of the gastric wall and diminished peristalsis it was thought that a possible carcinoma existed. Diagnosis was made of ulcer of the duodenum and pylorus, with possible infiltration of the lower third of the stomach. Operation showed only the duodenal and pyloric ulcers. A review of the gastric films showed one, two, and three fine rugae extending

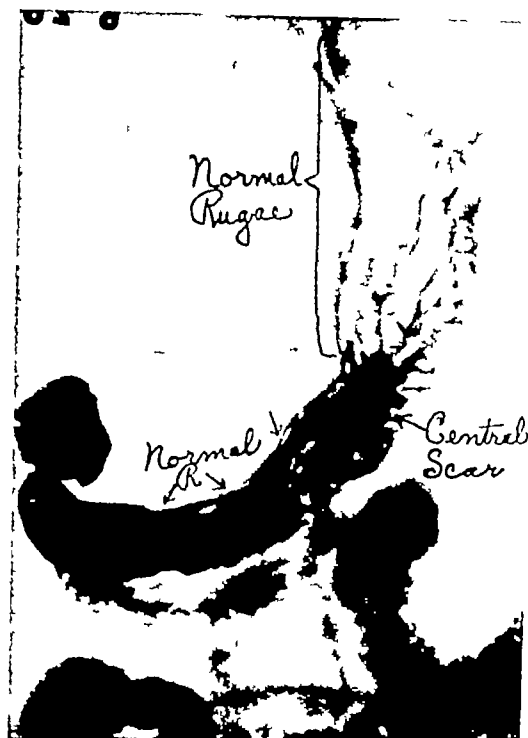


Fig 4



Fig 5

stomach. However, in some atrophic conditions the folds may be absent.

Scurrhous infiltration of the stomach wall has a tendency to destroy the muscular action and iron out the mucous membrane. The condition described as *limitis plastica* also thickens the stomach wall and makes it sufficiently rigid to obscure the mucosa folds. Polypoid growths attached to the stomach wall also destroy normal folds. Ulceration without gastric muscular infiltration will destroy the folds in the immediate vicinity of the ulcer, however, normal folds may be traced down to the ulcerative area and may be observed immediately distal to the ulcerative zone.

There is no intention in this paper to minimize any method that has been used such as different postures, palpation of the stomach wall, the amount of the stomach meal, and thorough fluoroscopic examinations.

The most essential procedure in outlining the gastric rugae is to get a proper barium suspension, using as little barium as possible suspended in a mucilaginous medium.

This barium suspension must be of such a character that no precipitation will occur. The quantity of the meal must be the smallest amount which will outline the mucosa folds. The quantity of barium in the suspension must not make the meal sufficiently dense to prevent energizing the film through the column of barium. Obviously, the quantity would vary with different patients.

Different types of folds have been described. The longitudinal folds, which run from cardia to pylorus, may be called the primary type. There is also a slightly transverse fold which is the result of extra deep longitudinal folds with subsequent transverse pleats due to an excessive amount of mucosa lining. Another peculiar irregular fold occurs along the greater curvature which seems to be the result of fine peristaltic movements in the gastric wall.

Most of the information is obtained from the more constant folds of the longitudinal type. The so-called transverse folds and those along the greater curvature are more variable in their appearance. It is not

A SIMPLE METHOD FOR DETERMINING THE DEGREE OF INSPIRATION FROM THE CHEST FILM¹

By KENNETH D A ALLEN, M D , and HAROLD D WALTZ, M D , with the Technical Assistance of DOROTHY D HANNER, *Denver*

From the Child Research Council and the University of Colorado School of Medicine

INTRODUCTION

A REVIEW of the available American and some foreign literature has failed to disclose a reference to a method of determining, from the roentgenogram itself, the degree of inspiration at which a radiograph of a chest is made. An x-ray examination of a co-operative patient assures a known phase of respiration if the proper radiographic technic is used. However, in younger children and unco-operative adults, the phase of respiration must be determined from the plates.

It is the purpose of this paper to show that a knowledge of the phase of respiration is vital to the interpretation of a radiograph of the lung-fields, especially in children. Also, it is our intent to describe a very simple method by which it may be determined by certain measurements on the roentgenogram itself. Roentgenograms made of healthy chests, when the lungs are in a state of incomplete inspiration, may show departures from the x-ray manifestations of normal lung-fields as they appear during complete inspiration which are practically indistinguishable from pathologic changes.

Most of the x-ray evidence of pulmonary or cardiac disease, upon which diagnostic opinion is based, is composed of the following x-ray signs:

- 1 Degree of intensification of the trunk shadow,
- 2 Mediastinal and cardiac contour,
- 3 Outline of the thymus gland,
- 4 Size, shape, and density of the hilum shadows,
- 5 Degree of aeration of the lung parenchyma,
- 6 Presence or absence of parenchymal

air displacement by infiltration or fibrosis,

- 7 Degree of visibility, size, and shape of lymphoid elements,
- 8 Shape, position, and contour of the domes of the hemidiaphragms,
- 9 Position and spacing of the ribs,
- 10 Size, outline, and position of the trachea and main stem bronchi

We will present evidence which indicates that practically all of these signs change to a greater or less degree with respiration. If these signs do change as does the phase of respiration, it seems futile to render an opinion on the condition of the lung-fields of an unco-operative child or adult unless the degree of inspiration during which the x-ray plate was exposed is positively known.

Evidence that respiration does alter these signs is furnished by Figure 1, which demonstrates the conspicuous diversity produced in the cases of three healthy co-operative children, by making plates at inspiration and at expiration in each case. These three children are clinically and radiographically (on other plates made at inspiration) free from any signs of pulmonary disease, and because of their co-operation we know the respiratory phase at which the plates are made. *A*, *b*, and *c* show complete expiration, *d*, *e*, and *f* are made at inspiration. Additional figures illustrating this article for other purposes, especially Figure 2, *a* and *c*, also show this same phenomenon. The factors of radiographic technic used for the plates made at inspiration are exactly the same as those which show the expiratory phase. The plates of both phases of respiration were made only a few minutes apart.

A comparative study of the plates representing the opposite phases of respiration discloses that all the signs listed above have been changed, at least in the degree of visi-

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis, Tenn., Dec. 1-7, 1934.

down to the pylorus. Had these rugæ been noticed on the first examination, the tentative diagnosis of malignancy would not have been made.

In conclusion, the following characteristics of the rugæ may be evaluated:

Carcinoma—The rugæ will be distinctly ironed out in the infiltrated area. Some of the longitudinal folds may circle the scirrhous zone or they may be completely effaced, to begin again on the opposite side of the growth.

Hypertrophic Gastritis—The rugæ become very wide and sometimes may not be identified as such. One stomach resembled the irregular lines of a jigsaw puzzle, with intervening plateau areas, with no evidence or resemblance of normal rugæ.

Polypoid Growths—The rugæ act in a very similar manner to those described in carcinoma. The normal folds do not stop

as abruptly as those shown when an ulcer is present.

Ulcer—The rugæ may be destroyed in the area of the ulcer and may cut off sharply at the edge of the crater. It is not uncommon for them to also circle the ulcer area. The constant deformity of the rugæ folds is to be noted when an ulcer is present.

The study of the gastric rugæ is important. We must exercise patience in getting the stomach properly filled, using, first, a very small dose of barium and adding to it as necessary to properly outline the rugæ. A correct suspension of barium must be used. Films must be made with sufficient rapidity to eliminate the movements of peristalsis and aortic pulsation.

Normal rugæ indicate a normal stomach wall. Deformed rugæ are indices of pathology and will give information on early carcinoma, gastritis with plateau-shaped areas of inflammation, gastric polyps, and gastric ulcer.

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INTRODUCTION

A REVIEW of the available American and some foreign literature has failed to disclose a reference to a method of determining, from the roentgenogram itself, the degree of inspiration at which a radiograph of a chest is made. An x-ray examination of a co-operative patient assures a known phase of respiration if the proper radiographic technic is used. However, in younger children and unco-operative adults, the phase of respiration must be determined from the plates.

It is the purpose of this paper to show that a knowledge of the phase of respiration is vital to the interpretation of a radiograph of the lung-fields, especially in children. Also, it is our intent to describe a very simple method by which it may be determined by certain measurements on the roentgenogram itself. Roentgenograms made of healthy chests, when the lungs are in a state of incomplete inspiration, may show departures from the x-ray manifestations of normal lung-fields as they appear during complete inspiration which are practically indistinguishable from pathologic changes.

Most of the x-ray evidence of pulmonary or cardiac disease, upon which diagnostic opinion is based, is composed of the following x-ray signs:

- 1 Degree of intensification of the trunk shadow,
- 2 Mediastinal and cardiac contour,
- 3 Outline of the thymus gland,
- 4 Size, shape, and density of the hilum shadows,
- 5 Degree of aeration of the lung parenchyma,
- 6 Presence or absence of parenchymal

air displacement by infiltration or fibrosis,

- 7 Degree of visibility, size, and shape of lymphoid elements,
- 8 Shape, position, and contour of the domes of the hemidiaphragms,
- 9 Position and spacing of the ribs,
- 10 Size, outline, and position of the trachea and main stem bronchi

We will present evidence which indicates that practically all of these signs change to a greater or less degree with respiration. If these signs do change as does the phase of respiration, it seems futile to render an opinion on the condition of the lung-fields of an unco-operative child or adult unless the degree of inspiration during which the x-ray plate was exposed is positively known.

Evidence that respiration does alter these signs is furnished by Figure 1, which demonstrates the conspicuous diversity produced in the cases of three healthy co-operative children, by making plates at inspiration and at expiration in each case. These three children are clinically and radiographically (on other plates made at inspiration) free from any signs of pulmonary disease, and because of their co-operation we know the respiratory phase at which the plates are made. *A*, *b*, and *c* show complete expiration, *d*, *e*, and *f* are made at inspiration. Additional figures illustrating this article for other purposes, especially Figure 2, *a* and *c*, also show this same phenomenon. The factors of radiographic technic used for the plates made at inspiration are exactly the same as those which show the expiratory phase. The plates of both phases of respiration were made only a few minutes apart.

A comparative study of the plates representing the opposite phases of respiration discloses that all the signs listed above have been changed, at least in the degree of visi-

¹ Presented before the Radiological Society of North America, at the Twentieth Annual Meeting in Memphis Tenn. Dec. 3-7 1934

bility, during the patient's respiration. If the criteria which determine the normal or abnormal state vary with breathing, it be-

at inspiration. The changes in the x-ray signs of the normal lung at inspiration (c), effected by a reversal of respiratory phase



Fig 1 Three normal children radiated at expiration (a b c) and inspiration (d e f) with duplicated technic. The diagnostic criteria change markedly with the phase of respiration.

comes obvious that, before an opinion can be rendered, the degree of inspiration must be known. Compare the plates (Fig 2) representing inspiration (c) and expiration (a) of a healthy child with a case of known disease (b) in which the plates were made

(a), seem even greater than the changes produced in the pathologic case by bronchopneumonia (b). The variation in the x-ray signs brought about by inspiration and expiration in normal cases have been tabulated to facilitate comparison (See Table I)

A study of this table discloses the fundamental changes in the diagnostic x-ray signs (Fig 2) As the lung-fields are depleted of air, these changes simulate disease Since it is impossible to routinely obtain radiographs in a known phase of respiration in infants and unco-operative patients, it becomes necessary to learn the degree of inspiration from the roentgenogram A roentgenologist is repeatedly confronted with a roentgenogram of the lung-fields made in only one phase of respiration, and that unknown It cannot be denied that in such a predicament a means of eliciting the degree of inspiration from the plate will greatly enhance the accuracy of interpretation Before describing the method of determining this, it is deemed advisable to briefly summarize the present status of the radiographic technic required for depicting the infant's chest

X-ray Technic—At this time there is no practical precision apparatus which automatically causes film exposure at complete inspiration The only way this can be routinely attempted in unco-operative patients is through visual determination by the technician Probably the best results are obtained when the operator assumes a position which places her eyes tangential to

the anterior or posterior body wall of the patient, closing the primary switch when the abdominal diameters assume the greatest proportions (Fig 3)

Figure 4 shows that one-half second or less is the limit of time during which an exposure of complete inspiration can be obtained Also, Figure 4 demonstrates that there may be more air in the lungs at all phases of respiration during a crying spell than during quiet breathing Therefore, more complete inspiration can be depicted on the plate if it is made during a crying spell

In our laboratory a couch with the tube beneath the patient permits the infant to lie on its back (the usual choice) with the plate held to the anterior chest wall by a special frame (Fig 3) The height of the table facilitates a tangential position of the technician's eyes (When plates are made in the erect posture by the swaddling or strapping methods, the technician should assume a position in which she can still keep her eyes in a tangential relationship) A further advantage is the shock-proof features which are combined with a machine of high power capacity This permits long object-plate distance and still furnishes adequate density with a one-twentieth of a

TABLE I —A COMPARISON OF CHANGES PRODUCED BY INSPIRATION AND EXPIRATION

	Inspiration	Expiration
Trunk shadows	Less intensified	More intensified
Mediastinum	Narrower and lower in chest	Broader and higher in chest
Thymic shadow	Narrower	Broader (may assume bizarre shape)
Hilum shadows	Longer and wider, less dense	Shorter and broader, more dense
Parenchyma	Increased aeration	Less aeration suggests parenchymal infiltrations
Lymphoid elements	Less visible	More visible
Diaphragm	{ Domes lower irregular and flatter Right dome generally higher than left	{ Domes higher smoother and more arched Right and left domes nearer same level
Carina	Lower	Higher
Trachea	Wider	Narrower
Heart	Lower and narrower more perpendicular	Higher and wider More horizontal (may assume abnormal and bizarre shapes)
Ribs	Horizontal apart	Slanting approximated

second exposure, producing good detail and sufficient contrast to make the detail visible. We find even with this equipment²

the posterior portion of a rib at the axillary border

This becomes more acute at inspiration

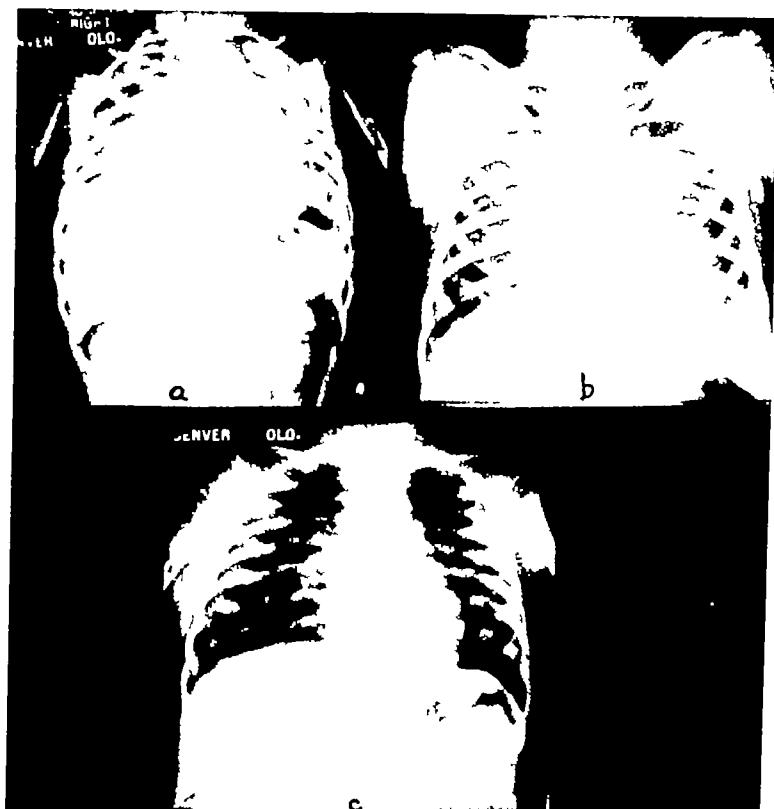


Fig 2 Expiration in a healthy child (a) suggests more disease than a known case of bronchial pneumonia (b) unless the phase of respiration is determined. C is the same as a taken in inspiration a few minutes later.

that it is difficult to obtain exposures at complete inspiration with any degree of certainty

AN X-RAY SIGN OF THE PHASE OF RESPIRATION

While seeking for a simple method of determining the phase of respiration from the x-ray plate, the following list of criteria was studied and applied to a large number of x-ray examinations of infants

1 *The angulation of the ribs with the spine*

This always approaches a right-angle at inspiration followed by some descent of the ribs at expiration

2 *The angle made by the anterior with*

but is found to be inconstant. Patients of different habitus show marked differences of this angle

2 *The angle of the heart outline in relation to perpendicular*

The heart changes to a more horizontal position with expiration, but because of wide variation of its position in relation to the habitus of an individual it was not found to be a reliable criterion of the degree of inspiration

4 *The change in the position of the clavicles*

The inner end of the clavicle rises markedly with inspiration, but this was found to be true only in the thoracic type of breathers

5 *The position and contour of the diaphragmatic domes*

² Installation by General Electric X-ray Corporation under Direction of W. Walter Wasson, M.D.

The height of the dome as compared to the spine is not a reliable sign of respiratory phase because in many cases its inner por-

mination The diaphragmatic contours, the costo-phrenic angles, and the position of the clavicles furnished the best evidence



Fig 3 No practical precision apparatus is available at this time for producing radiographs at complete inspiration in infants The tangential position of the technician's eyes enhances the results

tion is its highest part, and the outer two-thirds only change with respiration Furthermore in many cases in which serial x-ray examinations were made on the same co-operative child over a period of years at complete inspiration, it is noted that the level of the diaphragm descends as the patient grows older The contour of the diaphragm is irregular at complete inspiration because at this phase it is tonic

6 *The magnitude of the cardio-phrenic and costo phrenic angles*

As the diaphragm descends and the dome flattens, the angle made by the profile of the diaphragm and the lateral chest wall obviously becomes more obtuse No constant change is made in the cardio-phrenic angle by respiration

The significance of all these signs is inconstant and time consuming in its deter-

mination of the degree of inspiration The first and second were only of value in diaphragmatic or so-called abdominal breathers, and the third in thoracic breathers

Our effort to discover a single simple sign of the degree of inspiration was unfruitful until it was noted that in thoracic breathers the sternal ends of the clavicles raised during inspiration In the abdominal type the clavicles moved little while the diaphragmatic dome showed a relatively wide excursion It soon became obvious that the distance from the inner end of either clavicle to the middle point of the collateral hemidiaphragm is an index of the phase of respiration in nearly every patient, whether thoracic or abdominal breather Studies instituted to determine the value of this sign showed that it bore a constant relationship to respiration when compared with

the width of the chest. When the clavicular diaphragmatic distance equals two-thirds to three-quarters of the width of the chest distance cd (Fig 5) varied from six-tenths (0.6) to seven and one-half tenths (0.75), the width of the chest at complete inspira-

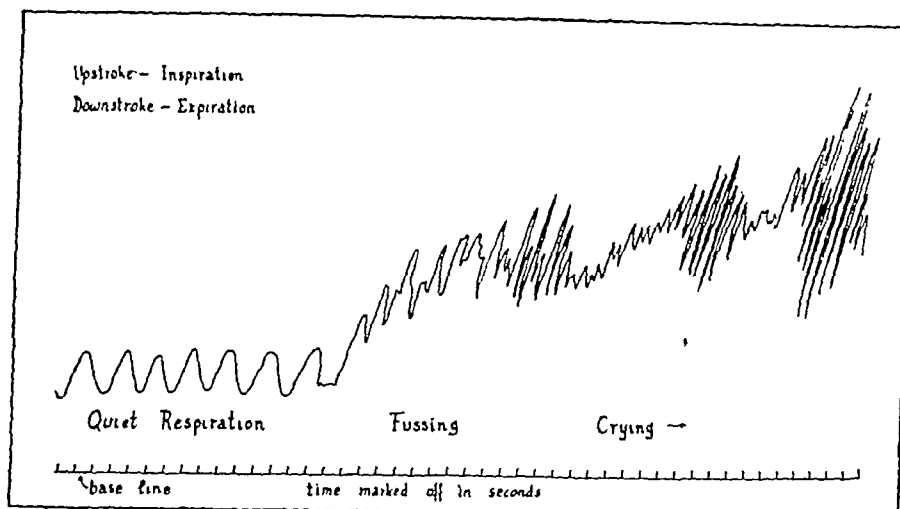


Fig 4 Tracing of infant's respiration (Deming and Washburn)

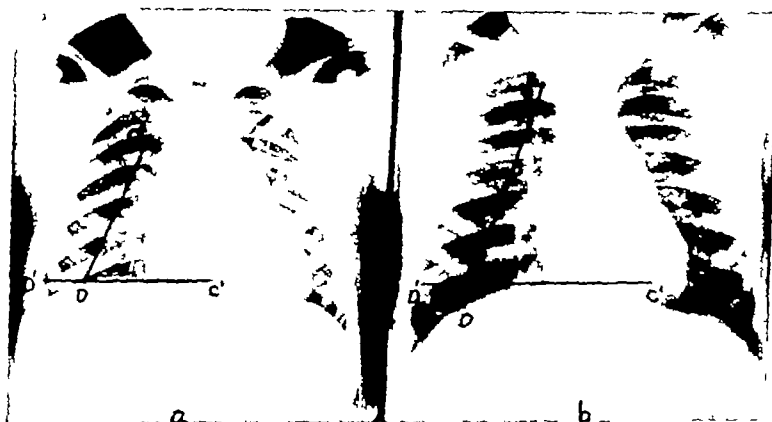


Fig 5 When the clavicular diaphragmatic distance equals two-thirds to three quarters of the width of the chest the plate represents approximately complete inspiration when only half the width of the chest complete expiration

chest, the plate represents approximately complete inspiration, when only half the width of the chest, complete expiration (Fig 5)

CLINICAL AND EXPERIMENTAL EVIDENCE

Fifty co-operative children, 22 boys and 28 girls, were radiated at complete inspiration and expiration. These children varied in age from three to ten years. In these cases of known degree of inspiration the

It varied from four and one-half tenths (0.45) to a little more than five-tenths (0.52), the width of the chest at complete expiration. Even in some cases in which the width of the chest varied because of unusual flaring of the lower ribs during inspiration we found the measurements to be within these limits.

Further clinical and experimental evidences of the accuracy of this sign was derived by radiating each of 20 unco-opera-

tive infants (eleven boys and nine girls, aged from one day to six weeks) while the

piration was traced on a smoked drum by means of a delicately balanced spirometer³

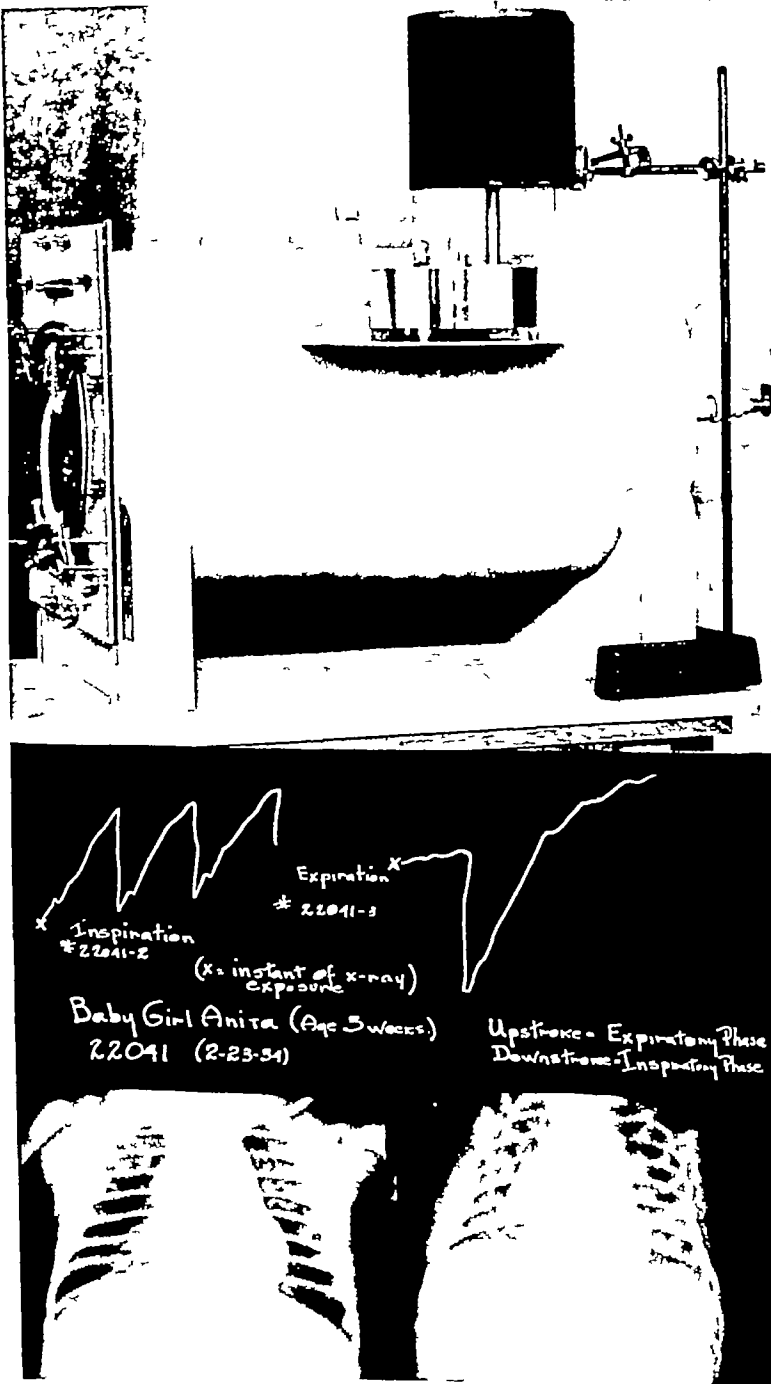


Fig 6 Respiration traced on a smoked drum by means of a delicately balanced spirometer

entire head was enclosed in a steel cylinder equipped with a rubber collar which prevented any material escape of air. Res-

(Fig 6) The x-ray plates show many dif-

³ Respiration in Infancy, J. Deming and A. H. Washburn Am Jour Dis Child in press

ferent phases of respiration. The instant of exposure was automatically recorded on the drum and thus indicated the exact phase of respiration at which each plate was made. Comparison of the clavicular diaphragmatic distance with the total width of the chest in these cases demonstrated the same relationship, numerically, as shown by the studies in the co-operative children. The younger the infant the closer the average relationship approached the minimum sixtenths (0.6) at inspiration.

We also studied the value of this λ -ray sign in adults. By means of a spirometer which measured the air intake and output, plates were made at a known phase of respiration. In each instance the cd line (Fig. 5) varied within the limits ascribed to infants. The adults showed a relatively longer cd line compared with the width of the chest than the infants, because the complete inspiration of the adults was forced.

In order to demonstrate that muscular movement, without the egress or ingress of air, which does not change the relationship of the cd line to the width of the chest, the following test was made. Two physicians, whose mouths were held closed and whose noses were compressed so that no air could pass, were radiated during a strenuous muscular effort to inspire and a similar effort to exhale. These plates were compared with plates made at inspiration and expiration. The ineffectual efforts, by muscular contraction, to breathe had no effect on the cd line.

For a year we have used this simple method, of evaluating lung markings resulting from disease and differentiating them from those due to incomplete inspiration, at the Child Research Council, Children's Hospital, and other hospitals, and in private office work. We feel in this practical application that we have greatly enhanced the value of our interpretations of unco-operative children's chests. By use of a ruler we can arrive at an opinion as to the degree of inspiration in less than a minute. This method applies equally well when plates are made in the prone, supine, or erect postures.

SUMMARY

1. A knowledge of the degree of inspiration is essential to the proper interpretation of an λ -ray examination of the lungs because a change in the respiratory phase changes the criteria upon which interpretation is based, especially in children.

2. There is no practical method of automatically exposing λ -ray plates of the chest at complete inspiration in unco-operative patients.

3. A simple rapid method for determining the degree of inspiration from the plate itself is described.

4. Experimental and clinical evidence which supports the accuracy of this method is contributed.

CASE REPORTS AND NEW DEVICES

ROENTGENOLOGIC CHANGES IN THE TRANSVERSE COLON IN PERITONEAL TUBERCULOSIS¹

CASE REPORTS

By J KAUFMAN, M D and I LEVINE, M D,
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From the Roentgen ray Department of the
Harbor Hospital

It is surprising how little roentgenologic literature can be found on the subject of peritoneal tuberculosis. Tubercular peritonitis may occur as an acute miliary tuberculosis or it may be secondary to a tubercular inflammation elsewhere. The process may be localized to one area or it may involve the entire peritoneum. The lesions themselves may be miliary in char-

The transverse colon serves as a point of attachment for the omentum and as the omentum is carried high up in the abdomen, it must carry the transverse colon with it. In the advanced case, one finds a rolled-up, sausage-shaped omentum closely associated with the transverse colon occupying an unusually high position in the abdomen.

The liver and spleen are very commonly involved in the tubercular process. Increase in size of both organs occurs as a result of the tuberculous infection.

If a roentgenologic study is made in a case of peritoneal tuberculosis in which a rolled-up omentum is present, one finds that the transverse colon is (1) elevated, (2) fixed, (3) shortened, (4) inelastic. Definite changes also

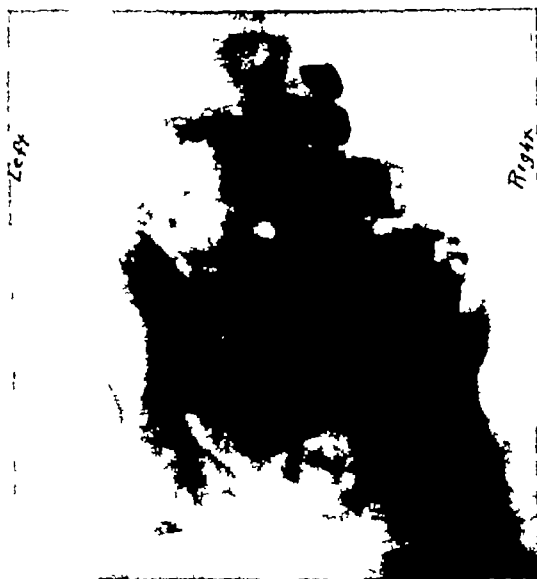


Fig 1 A four hour plate of Case 1 showing the approximation of the stomach and transverse colon the shortening and elevation of the transverse colon the altered angles at the hepatic and splenic flexures and the altered haustral state of the entire colon



Fig 2 A colon enema plate of Case 1 showing distinctly the elevation and shortening of the transverse colon the cupping of the splenic flexure, and the altered angles at both flexures (greater than right angles in this case)

acter or there may be large foci of new formed tubercle tissue with considerable necrosis. There may be a more or less sero-fibrinous, purulent, or hemorrhagic exudate. Fibrous adhesions may form between the intestinal coils and the peritoneal wall with encapsulation of the exudate. The tuberculous inflammation may be limited to the vicinity of the ulcers of the intestines. The process may involve the omentum, which is converted into a large, hard, thick dense mass lying in the upper part of the abdomen.

take place at the hepatic and splenic flexures—the former becomes flattened and the latter shows cupping.

The elevation, fixation, shortening, and loss of elasticity of the transverse colon needs no comment here, except to note that the degree varies with the extent of involvement of the omentum.

Just a word about the flattening of the hepatic flexure and the cupping of the splenic flexure. As the transverse colon is elevated, the ascending colon and descending colon do

¹Received for publication July 2, 1934



Fig 3 A forty-eight hour plate of Case 2, showing the elevation and shortening of the transverse colon, the altered haustral state, and the altered angles at the flexures

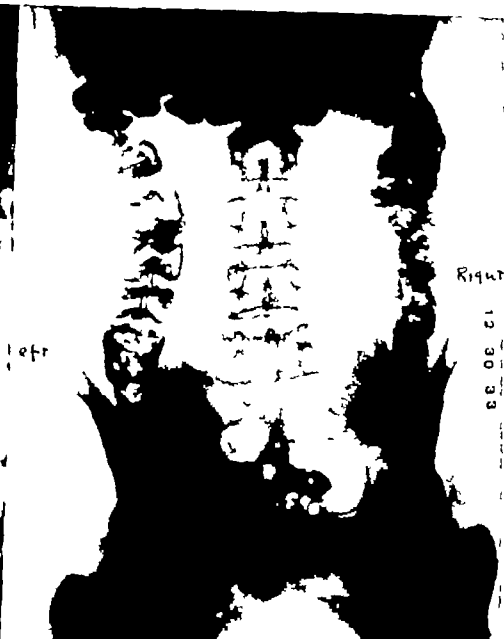


Fig 4 A twenty-four-hour plate of Case 3 showing the elevation and shortening of the transverse colon, the widening of both flexure angles, the flattening of the apex of the hepatic flexure angle, and the cupping of the splenic flexure angles

not participate to the same degree. At the same time there is an enlargement of the liver and spleen, producing a downward displacement of both flexures. As a result of both processes, the hepatic flexure becomes flattened and the splenic flexure becomes cupped. Adhesions between the flexures and the liver and spleen tend to accentuate this condition.

There are necessarily secondary changes in other organs resulting from the infection. The distance between the greater curvature of the stomach and the transverse colon becomes smaller. One also gets the impression that the stomach is foreshortened and the longitudinal axis decreased so that the stomach approaches the transverse type. The mobility of the stomach is somewhat impaired. In the chest the diaphragmatic motions may be decreased in amplitude. There are sure to be functional changes in the outline of the colonic wall itself, such as altered haustral states, probably reflexes from peritoneal irritation.

The above findings are not, of course, pathognomonic of peritoneal tuberculosis, since they may and do occur in other forms of peritonitis in which the omentum is involved in a similar process.

X-ray films and case histories of three cases of peritoneal tuberculosis, associated with rolled-up omentum, proven by operation, are presented below.

Case 1 B M, female, age 20 years, complaining of pain in right side following an attack of indigestion. There is no nausea or vomiting. The appetite is poor. She has lost fifteen pounds in weight during the last two years. She has had night sweats for the past three months, no hemoptosis or cough.

Physical examination shows an anemic patient, the abdomen is tense, rigid, and distended, the spleen is palpable and extends almost to the umbilicus, the liver is not palpable. There is marked tenderness over the right lower quadrant. The heart and lungs are negative, as is the genito-urinary tract. The blood picture shows secondary anemia, the urine is negative.

Operation reveals a large amount of yellow fluid in the peritoneal cavity, the intestines held down by exudate, the peritoneum thick and studded with tubercles, the omentum rolled up and high in the abdomen.

Case 2 C N, female, age 25 years, complaining of vomiting, diarrhea, and cramps for four months. The appetite is poor, there has been no loss of weight, no cough or hemoptosis.

Physical examination shows a patient with a secondary anemia. There is slight lower abdominal distention, and tenderness over the left lower quadrant. Intestinal loops are palpable at the time of cramps.

Operation reveals tuberculous involvement of the lower jejunal and ileal loops, the omentum is rolled up and high in the abdomen. The diagnosis is peritoneal tuberculosis.

Case 3 B S, female, age 30 years, complaining of loss of appetite for the past six months. She noticed a mass in the abdomen three weeks prior to admission, pain has been present in the right lower quadrant.

Physical examination shows a mass the size of a grape fruit in the right mid-abdomen. Tenderness is present in the right lower quadrant, the abdomen is not distended.

Operation reveals a peritoneum studded with small tubercles. The omentum is thickened, rolled up, and high in the abdomen. The colon is covered with plastic exudate.

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1219—49th Street

CALCIFICATION OF THE SPLENIC ARTERY

By JOHN L HEATLEY, M D, *Oklahoma City Oklahoma*

From the Departments of Roentgenology and Anatomy of the State University of Oklahoma School of Medicine

Search of the literature does not reveal any mention of calcification of the splenic artery having been demonstrated by the x-ray. For this reason the following cases are submitted.

Figure 1 is an antero-posterior view of an anomalous calcified splenic artery in a white female aged 72, which was confirmed at operation. Following an operation for an abdominal injury when 23 years of age, the patient was in bed for three years with drainage of pus from the abdomen. This history caused us to suspect the shadows of the splenic artery, shown in Figure 1, to be due to a rather opaque retained drainage tube. At operation a large calcified splenic artery was found.

We have seen six other cases with similar radiographic appearance, none of which were



Fig 1

confirmed by operation or autopsy. None of the patients complained of pain over the region of the splenic artery. They had no symptoms in common. All patients except two were obese white females over 72 years of age. The number of these cases in our files would indicate that the condition is not uncommon. One case of calcified splenic artery had a small spleen, the splenic artery being slightly longer and more tortuous than the average.

A COMPOSITE UNIT FOR SINUS-MASTOID AND GASTRO-DUODENAL RADIOGRAPHY¹

By W W ROBINSON M D, *Memphis Tennessee*

This device supplies the need for a practical, compact, light-weight, inexpensive apparatus in the small laboratory, with which diagnostic stereoscopic radiographs of the nasal accessory sinuses and mastoids, as well as serialographic studies of the stomach and duodenum, may be made.

Its assembly incorporates two principles. First, that of the 'Reflex' Sinus mastoid Unit introduced by John R. Cartwright (1), of

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis Tenn. Dec 3-7 1934.

dental high tension shock After the desired image is properly centered by means of the shadows of the cross-wires in the mirror, the fluoroscopic screen is removed, and an 8 by 10 inch cassette is inserted in the tunnel in either the transverse or longitudinal body plane by the use of a wooden frame specially constructed for the purpose A series of 8 by 10 inch films are made in several positions for study

The apparatus is well adapted to the use of the Lysholm grid of the $12\frac{1}{2}$ by $13\frac{1}{2}$ inch size, both for screening and plating the stomach and duodenum On account of the increased definition it offers, it is used routinely in all of our cases The reduction in intensity of radiation by its employment in radiography is compensated for by the addition of only 10 K V P to the tube factors

For radiographs taken under compression as well as those protraying the mucosal pattern of the stomach and cap according to Chaoul and Akerlund, a rubber bladder countersunk in a 9-inch circular aperture in a wooden frame, and operated by a rubber bulb and two-way valve (similar in principle to that embodied in the Improved Cassette Holder of Heylmun and Mayfield, 3) is placed over the surface of the unit Counter-pressure on the stomach and cap may be exerted in any degree in any position It may be employed in conjunction with the Lysholm grid, and deflated, it may be left in position during all of the gastro-duodenal examinations

It is believed that the low cost of films used, and the wealth of detail and contrast shown in these, along with the optimum in position secured by the device, which is so essential to accurate diagnostic interpretation, should fully compensate the roentgenologist for its installation

Although permission is granted any company to manufacture it, the author offers this innovation to the profession with the sincere wish that it shall never be patented or commercialized in any manner He also wishes to commend Mr T G Drane, of Memphis, for the earnest co-operation and mechanical skill shown by him in building the apparatus

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1291 Union Ave

AN AID IN DETERMINING THE POSITION OF THE UTERUS

By JOHN M KEICHLINE, M D *Huntingdon, Pa*

I wish to report a case in which retroflexion of the uterus was accidentally discovered at roentgen-ray examination

Two young married women were sent to me for x-ray examination of the coccygeal region On developing the films I found that both of them were wearing stem pessaries The positions of the pessaries were so diametrically opposite that I reported the position of one as being highly suggestive of a retro-flexed uterus (Fig 1) The patient's physician said he had examined her and that the uterus was in a normal position

I later learned that this young woman was pregnant and that she had consulted an obstetrician I at once told him of my findings and



Fig 1

he replied that they had been correct He discovered the malposition in his examination and had replaced the uterus

This report may serve to call attention to cases in which there is a question of retroflexion of the uterus

ARE WE MAKING PROGRESS IN DIAGNOSING CANCER IN ITS EARLY STAGES?

We radiologists have observed repeatedly that a large percentage of the cancer cases we diagnose and treat are far advanced when we first see them, and no doubt physicians of other specialties have had the same experience. This serious condition has been the cause for a great deal of thought and investigation on the part of the medical profession. All of us appreciate that the early recognition of cancer would materially reduce its mortality rate. It is apparent that many of the early cancer cases go undiagnosed, or else they do not produce sufficient symptoms to cause the patient to seek the advice of a physician. Be that as it may, we have to admit that little progress is being made in the early recognition of cancer, due either to the fault of the attending physician or the patient himself.

Recently MacCarty, of the Mayo Clinic, mentioned the following facts in a discussion of why cancer is not recognized early:

(1) From 30 to 50 per cent of cases of cancer of the breast (Harrington), 42 per cent of cases of cancer of the large intestine (Rankin), and 75 per cent of cases of the stomach (Balfour) are inoperable when first seen in the Mayo Clinic.

(2) Sixty-two per cent of the operable cancers of the breast, 38 per cent of cancers of the large intestine, and 53.5 per cent of cancers of the stomach have metastasized to regional lymph nodes when seen.

(3) The average size of operable cancers of the breast is 3.2 cm in diameter, of those of the large intestine 6.4 cm, and of those of the stomach 6.1 centimeters.

(4) Only 29 per cent of operable cancers of the breast are smaller than a quarter (2.5 cm), and this is true of only 2.2 per cent of cancers of the large intestines and only 6 per cent of cancers of the stomach.

While it is true that the lesions of early cancer are at times so small that it is impossible to recognize them macroscopically, if accessible to observation at all, yet the large majority are sufficiently large to be recognized

if concerted effort is made. MacCarty reports that out of 7,179 specimens of surgically removed cancers, the smallest found in the breast was 2 mm in diameter, in the large intestine 9 mm, and in the stomach 5 millimeters.

To say that a large number of early cancers are not recognized does not mean that medicine has not progressed comparable to the fields of industry and pure science, on the contrary, it has made rapid and startling strides in the diagnosis of disease and particularly cancer. In the early diagnosis of cancer, transillumination, aspiration biopsy, microscopical tissue examinations, and the use of the roentgen ray—the single or combined use of these agencies—all have been of tremendous importance. But in spite of this, we must admit that too many such cases are permitted to go unrecognized. Insufficient training and experience of the general medical men, too little regard for one's own limitations in this regard, and dependence on the roentgen ray in the hands of inexperienced and unqualified users of it are some of many causes for this apparent shortcoming of the medical profession. In this regard we heartily agree with MacCarty, that "Cancers are not recognized early by the medical profession and *never will be* until it learns that there are *no characteristic signs and symptoms* for early cancer and the *only means of telling whether the condition is gastric, duodenal, appendiceal, or in the gall bladder is the roentgen ray*." What a tremendous difference it would make if the rank and file of the medical profession would recognize this truth, then and only then would a change become noticeable, instead of having to treat such a large number of hopeless and inoperable cancer cases.

There has been during the last few years a tremendous cancer educational program which has resulted in manifesting a great interest among the lay people concerning the cancer problem. It is to be hoped that its effect will be the means of cancer patients presenting themselves in the early stages of the disease.

The mortality rate of cancer is very high, much too high, but it can be materially reduced by the co operation of the cancer patient with the medical profession, for an earlier diagnosis

ANNOUNCEMENTS

AMERICAN BOARD OF RADIOLOGY

The following is a list of the diplomates of the American Board of Radiology who ap-

peared before the Board and passed a satisfactory examination in Cleveland, Pittsburgh, or Memphis and who were granted certificates

DIPLOMATES OF THE AMERICAN BOARD OF RADIOLOGY

(January 1, 1935)

Name	Address	Field
1 Allen, Bundy	Tampa Fla	Radiology
2 Allen Kenneth Dayton Allison	Denver Col	Radiology
3 Allen, Lewis G	Kansas City Mo	Radiology
4 Allen, Moore Lowry	Philadelphia Pa	Radiology
5 Alley, Reuben G	Pittsburgh Pa	Diagnostic Roentgenology
6 Allison, R G	Minneapolis Minn	Roentgenology
7 Ané Joseph Novell	New Orleans La	Radiology
8 Archer, Vincent William	University, Va	Roentgenology
9 Arens, Robert A	Chicago Ill	Roentgenology
10 Ashbury Howard C	Baltimore Md	Roentgenology
11 Atkins Samuel M	Waterbury, Conn	Roentgenology
12 Aurelius J Richards	St Paul Minn	Roentgenology
13 Bachman M H	Youngstown Ohio	Roentgenology
14 Bader Ellis R	Cincinnati Ohio	Radiology
15 Bailey, Wilbur	Philadelphia Pa	Radiology
16 Baker, Charles Frederick	Newark, N J	Roentgenology
17 Baker, Edgar C	Youngstown, Ohio	Radiology
18 Barnes John McGregor	Buffalo, N Y	Roentgenology
19 Barrow Sidney Conroy	Shreveport La	Radiology
20 Barth Earl E	Chicago, Ill	Roentgenology
21 Bauer, August A	Chicago Ill	Roentgenology
22 Baum Samuel M	New York, N Y	Therapeutic Radiology
23 Beeler, Raymond Cole	Indianapolis, Ind	Radiology
24 Beihn, D S	Chicago Ill	Radiology
25 Bell Joseph Clark	Louisville Ky	Roentgenology
26 Benishek, Werner L	Aurora Ill	Roentgenology
27 Benjamin, Emanuel William	Providence R I	Radiology
28 Berg H Milton	Bismarck N D	Radiology
29 Bethea, William R	Memphis Tenn	Roentgenology
30 Bishop Paul A	Philadelphia Pa	Radiology
31 Blackett Charles W	Boston Mass	Roentgenology
32 Blaine, Edward S	Los Angeles Cal	Roentgenology
33 Bliss Gerald D	Altoona Pa	Radiology
34 Bogan, Isabel Katherine	Boston Mass	Roentgenology
35 Bogan, Mary Elizabeth	Brookline Mass	Roentgenology
36 Bogart, Franklin B	Chattanooga Tenn	Roentgenology
37 Borzell, Francis Frank	Philadelphia Pa	Radiology
38 Bowen David Ralph	Philadelphia Pa	Radiology
39 Bowing H H	Rochester Minn	Therapeutic Radiology
40 Brams, Julius	Chicago Ill	Radiology
41 Brennenman, Richard E	Meadville Pa	Therapeutic Radiology
42 Bromer, Ralph S	Bryn Mawr Pa	Radiology
43 Brooksher William Riley	Fort Smith Ark	Radiology
44 Brouse, Ivan Edwin	Jacksonville Ill	Roentgenology
45 Brown, Percy	Boston Mass	Roentgenology
46 Brown, Samuel	Cincinnati Ohio	Roentgenology
47 Bryan, Lloyd	San Francisco Cal	Roentgenology
48 Burcham Thos A	Des Moines Iowa	Radiology
49 Butler, P P	Boston Mass	Radiology
50 Caldwell Charles S	Pittsburgh Pa	Roentgenology
51 Camp John Dexter	Rochester Minn	Roentgenology
52 Capp, Charles S	San Antonio Tex	Radiology
53 Carter, Ray Alden	Los Angeles Cal	Roentgenology
54 Carty, John Russell	New York N Y	Radiology
55 Case James Thomas	Chicago Ill	Radiology
56 Cathcart John Watson	El Paso Tex	Radiology
57 Challenger, Chester John	Chicago Ill	Roentgenology

	Name	Address	Field
58	Chamberlain W Edward	Philadelphia, Pa	Radiology
59	Childs Donald Smythe	Syracuse, N Y	Roentgenology
60	Christie Arthur Carlisle	Washington, D C	Radiology
61	Clark, James J	Atlanta, Ga	Roentgenology
62	Clark, Stanley A	South Bend, Ind	Radiology
63	Clement Gage	Duluth Minn	Radiology
64	Coe, Frederick O	Washington, D C	Radiology
65	Cole Lewis Gregory	New York City	Roentgenology
66	Coley, Stephen W	Memphis, Tenn	Roentgenology
67	Collins, James N	Indianapolis Ind	Radiology
68	Collins John Joseph	Thomasville Ga	Radiology
69	Corcoran, William Joseph	Old Forge, Pa	Roentgenology
70	Costolow, William Evert	Los Angeles, Cal	Therapeutic Radiology
71	Cram, Carroll Francis	Corpus Christi Tex	Radiology
72	Cramp George W	Brooklyn, N Y	Roentgenology
73	Crane, Augustus Warren	Kalamazoo, Mich	Roentgenology
74	Crossan, John W	Los Angeles, Cal	Diagnostic Roentgenology
75	Crowder, E R	Chicago Ill	Roentgenology
76	Cunningham Lester W	Jacksonville Fla	Roentgenology
77	Curran, Francis W	Brooklyn N Y	Roentgenology
78	Cushway Bertram Charles	Chicago Ill	Radiology
79	Dann, David S	Kansas City Mo	Radiology
80	Davidson Sol C	Rochester, N Y	Roentgenology
81	Davis Henry B	Lancaster Pa	Radiology
82	Davis Kenneth S	Los Angeles, Cal	Roentgenology
83	Decker Fred Henry	Peoria, Ill	Radiology
84	Derr, John Sebastian	Frederick, Md	Roentgenology
85	Desjardins, Arthur U	Rochester Minn	Radiology
86	Deweese E R	Kansas City, Mo	Radiology
87	Dickinson, Joshua C	Tampa, Florida	Roentgenology
88	Donaldson Samuel Wright	Ann Arbor Mich	Roentgenology
89	Doub Howard Philip	Detroit Mich	Radiology
90	Doughty William M	Cincinnati, Ohio	Radiology
91	Downs, Elwood Emerson	Woodbury N J	Radiology
92	Drane Robert	Savannah Ga	Roentgenology
93	Dunham H Kennon	Cincinnati Ohio	Diagnostic Roentgenology
94	Eastmond Chas	Brooklyn N Y	Roentgenology
95	Edwards Harold Guegnon Fabien	Shreveport La	Radiology
96	Edwards James Bennett	Leonia N J	Roentgenology
97	Fley Clayton W	Norfolk Va	Roentgenology
98	Elward Joseph Francis	Washington D C	Roentgenology
99	Ernst Edwin C	St. Louis Mo	Radiology
100	Erskine Arthur Wright	Cedar Rapids Iowa	Radiology
101	Ivans William A	Detroit Mich	Radiology
102	Evleth Fred Shailer	Concord N H	Roentgenology
103	Farmer Harry L	Cleveland Ohio	Radiology
104	Farrall John T Jr	Philadelphia Pa	Roentgenology
105	Feaster Orion Otis	St Petersburg Fla	Radiology
106	Ferguson, James W	Pittsburgh Pa	Radiology
107	Flynn James Murray	Rochester N Y	Radiology
108	Ford Frances A	Detroit Mich	Radiology
109	Fry Walter Wendell	Rochester N Y	Radiology
110	Freedman Eugene	Cleveland Ohio	Roentgenology
111	Freedman John	Detroit Mich	Roentgenology
112	Fried Jacob R	New York N Y	Therapeutic Radiology
113	Frick Robert Elmer	Rochester Minn	Therapeutic Radiology
114	Friedman Jacob	Montreal Quebec	Roentgenology
115	Friedman Milton	Newark N J	Therapeutic Radiology
116	Fury Warren W	Chicago Ill	Radiology
117	Garland L Henry	San Francisco Cal	Radiology
118	Gates Russell	Minot N D	Roentgenology
119	Gerber Isaac	Providence R I	Radiology
120	Gershon Cohen Jacob	Philadelphia Pa	Radiology
121	Geyman Milton J	Santa Barbara Cal	Diagnostic Roentgenology
122	Granturo Cesare	Urbana Ill	Roentgenology
123	Gillis Carl I	Cedar Rapids Iowa	Radiology
124	Goin Lowell S	Los Angeles Cal	Roentgenology
125	Golden Ross	New York N Y	Roentgenology
126	Goldsmith Maurice F	Pittsburgh Pa	Roentgenology
127	Goodrich Murray Eugene	Toledo Ohio	Radiology
128	Goodwin Perry Bird	Peoria Ill	Radiology
129	Gorsline Clarence S	Battle Creek Mich	Roentgenology
130	Granger Amides	New Orleans La	Diagnostic Roentgenology
131	Grier George W	Pittsburgh Pa	Radiology
132	Groover Thomas Allen	Washington D C	Radiology

	Name	Address	Field
133	Habbe, J Edwin	Milwaukee, Wis	Diagnostic Roentgenology
134	Hall, E Walter	Detroit, Mich	Radiology
135	Hankins John Logan	Johnson City, Tenn	Roentgenology
136	Harding Donnan B	Lexington, Ky	Radiology
137	Harrington Bernard D	Tacoma, Wash	Radiology
138	Harris John H	Harrisburg, Pa	Radiology
139	Hartung Adolph	Chicago Ill	Roentgenology
140	Hasley, Clyde Knapp	Detroit, Mich	Radiology
141	Hauser Harry	Cleveland Ohio	Radiology
142	Hawley, Sydney James	Danville, Pa	Roentgenology
143	Hay, Percy D, Jr	Florence, S C	Radiology
144	Heacock, Charles Hunter	Memphis, Tenn	Roentgenology
145	Healy, Thomas Raymond	Boston, Mass	Roentgenology
146	Heatley, John E	Oklahoma City Okla	Diagnostic Roentgenology
147	Heberding, John	Youngstown Ohio	Radiology
148	Hefke Hans W	Milwaukee Wis	Radiology
149	Hendricks, Elliott Miley	Ft Lauderdale Fla	Roentgenology
150	Hendrickson, Anna R	Canton, Ohio	Roentgenology
151	Henry Lucas Smith	Syracuse N Y	Diagnostic Roentgenology
152	Herpel Frederick Karl	West Palm Beach Fla	Roentgenology
153	Herrman William Gettier	Asbury Park N J	Radiology
154	Hill Walter Coit	Cleveland, Ohio	Roentgenology
155	Hilt, Lawrence Mershon	Springfield, Ill	Roentgenology
156	Hodges, Fred Jenner	Ann Arbor, Mich	Radiology
157	Hodges, Fred M	Richmond Va	Radiology
158	Hodges, Paul C.	Chicago Ill	Radiology
159	Holly Leland E	Muskegon, Mich	Roentgenology
160	Holmes, George Winslow	Boston, Mass	Radiology
161	Holmes Ralph Williams	Chillicothe Ohio	Roentgenology
162	Howes William Edward	Brooklyn N Y	Radiology
163	Hubeny, Maximilian John	Chicago, Ill	Roentgenology
164	Hufford C E	Toledo, Ohio	Radiology
165	Hunt, Howard B	Omaha Neb	Radiology
166	Hunter James Wilson, Jr	Norfolk, Va.	Radiology
167	Ikeda Kano	St Paul Minn	Roentgenology
168	Imboden Harry M	New York N Y	Roentgenology
169	Ivey H B	Goldsboro N C.	Diagnostic Roentgenology
170	Jaches Leopold	New York N Y	Radiology
171	Jackson, Byron Hubbard	Scranton Pa	Radiology
172	Jacox, Harold William	Ann Arbor Mich	Radiology
173	Jarre Hans A	Detroit Mich	Radiology
174	Jenkinson Edward L	Chicago Ill	Radiology
175	Johnson, Ellsworth	Winchester Va	Diagnostic Roentgenology
176	Johnson Jesse B	Galveston, Tex	Radiology
177	Johnson Vincent Clifton	Ann Arbor, Mich	Radiology
178	Kahn Max	Baltimore Md	Roentgenology
179	Kalbfleisch William K	Wheeling W Va	Roentgenology
180	Kann Ulysses S	Binghamton N Y	Radiology
181	Kaplan Ira I	New York, N Y	Therapeutic Radiology
182	Kasabach Haig Haigouni	New York N Y	Radiology
183	Keichline John M	Huntingdon Pa	Radiology
184	Keith, David Yandell	Louisville Ky	Radiology
185	Kelly James Francis	Omaha, Neb	Radiology
186	Kenning John Carl	Detroit Mich	Radiology
187	Kerby James P	Salt Lake City Utah	Roentgenology
188	Kerr H Dabney	Iowa City, Iowa	Radiology
189	Kinney Lyell Cary	San Diego, Cal	Radiology
190	Kirklin B R	Rochester Minn	Radiology
191	Kolvoord Theodore	Battle Creek, Mich	Diagnostic Roentgenology
192	Kornblum Karl	Philadelphia Pa	Radiology
193	Kuegle Frederick H.	Janesville, Wis	Diagnostic Roentgenology
194	Lafferty Robert Hervey	Charlotte N C	Radiology
195	Lange Sidney	Cincinnati Ohio	Radiology
196	Langer Heinz	Pittsburgh Pa	Therapeutic Radiology
197	Larkey Charles J	Bayonne N J	Diagnostic Roentgenology
198	Lattman Isidore	Washington D C	Radiology
199	Lawrence, W S	Memphis Tenn	Radiology
200	Leddy Eugene Thomas	Rochester Minn	Roentgenology
201	Leibert Harry F	Bethlehem, Pa	Therapeutic Radiology
202	Lenz Maurice	New York N Y	Roentgenology
203	Leonard Ralph D	Boston, Mass	Radiology
204	Leucutia Traian	Detroit Mich	Diagnostic Roentgenology
205	Levi Irwin P	Anniston Ala	Diagnostic Roentgenology
206	Le Vine David	Eldorado Ark	Diagnostic Roentgenology
207	Levyn Lester	Buffalo N Y	Roentgenology
208	Lhevine Morris B	Tulsa Okla	

	Name	Address	Field
209	Lingeman, Leslie Roberts	Rochester N Y	Roentgenology
210	Littig Lawrence Victor	Madison, Wis	Diagnostic Roentgenology
211	Lochry, Ralph L	Indianapolis, Ind	Roentgenology
212	Lockwood Ira H	Kansas City, Mo	Radiology
213	Lucinian Joseph H	Miami, Fla	Roentgenology
214	Lutz Jeremiah Fletcher	York, Pa	Roentgenology
215	McClure Christopher C	Nashville Tenn	Radiology
216	McCormick, Arthur Foster	Dubois Pa	Diagnostic Roentgenology
217	McCormick, Henry Garnsey	Laurel, Miss	Roentgenology
218	McCullough John Fife	Pittsburgh, Pa	Radiology
219	McDeed Winfield G	Houston, Tex	Roentgenology
220	McDermott Joseph L	Kansas City, Mo	Radiology
221	McElfatrick George Charles	Wilmington, Del	Roentgenology
222	McGee, Harry Hand	Savannah Ga	Diagnostic Roentgenology
223	McGuffin W Herbert	Calgary, Alberta	Radiology
224	McHenry R K	Houston, Tex	Roentgenology
225	McKinney Joseph T	Roanoke, Va	Roentgenology
226	McNamee Edgar Paul	Cleveland, Ohio	Diagnostic Roentgenology
227	McNutt John Roscoe	Duluth, Minn	Radiology
228	Magruder L Freeland	Norfolk, Va	Radiology
229	Maier Roe J	Chicago, Ill	Radiology
230	Malone L A	Terre Haute Ind	Diagnostic Roentgenology
231	Mandeville Frederick B	Richmond, Va	Roentgenology
232	Manges, Willis I	Philadelphia, Pa	Radiology
233	Marquis W James	Newark, N J	Roentgenology
234	Martin Charles Louis	Dallas, Tex	Radiology
235	Martin, James Madison	Dallas Tex	Radiology
236	May, Ernst Albert	East Orange N J	Radiology
237	May, Robert John	Cleveland, Ohio	Radiology
238	Mayfield Claud	Long Beach, Cal	Diagnostic Roentgenology
239	Meadows, James Allen	Birmingham, Ala	Radiology
240	Meland, Orville Newton	Los Angeles, Cal	Therapeutic Radiology
241	Menees, Thomas Orville	Grand Rapids, Mich	Radiology
242	Menville Leon J	New Orleans, La	Radiology
243	Merchant Albert K	Philadelphia, Pa	Radiology
244	Meyer, Keith Thomas	Evansville, Ind	Roentgenology
245	Meyer William H	New York, N Y	Radiology
246	Milkman Louis A	Scranton Pa	Roentgenology
247	Minor Edward G	Detroit, Mich	Diagnostic Roentgenology
248	Moore A B	Washington, D C	Radiology
249	Moore Claude	Washington, D C	Radiology
250	Moore John Jay	Washington D C	Radiology
251	Moore Paul David	Muncie Indiana	Radiology
252	Moore Sherwood	St Louis Mo	Radiology
253	Moore, Vernor Milo	Grand Rapids, Mich	Radiology
254	Morse Russell Wright	Minneapolis Minn	Roentgenology
255	Morton Silvanus Archibald	Milwaukee, Wis	Radiology
256	Moxness, Bennie Arthur	Northampton, Mass	Diagnostic Roentgenology
257	Mulligan Peter Burnill	Ashland Pa	Roentgenology
258	Murphy Gibbons Westbrook	Asheville, N C	Roentgenology
259	Murphy John T	Toledo Ohio	Radiology
260	Myers Ralph E	Oklahoma City, Okla	Radiology
261	Nessa Nehus Julian	Sioux Falls S D	Roentgenology
262	Newcomet William Stell	Philadelphia, Pa	Radiology
263	Nichols Bernard H	Cleveland Ohio	Radiology
264	Nichols Harold E	Seattle, Wash	Diagnostic Roentgenology
265	Nordin, Gustaf Theodore	Minneapolis Minn	Radiology
266	O'Brien, Frederick William	Boston, Mass	Radiology
267	Ohn, Harry	Chicago Ill	Roentgenology
268	Orndoff, Benjamin Harry	Chicago Ill	Radiology
269	Orr, Clifford R.	Buffalo, N Y	Radiology
270	Osmond, John D	Cleveland, Ohio	Roentgenology
271	Overgaard Anders P	Omaha Nebraska	Radiology
272	Owen, Arthur K.	Topeka, Kansas	Roentgenology
273	Paine Robert	Memphis, Tenn	Radiology
274	Palmer, Dorwin Lewis	Portland, Ore	Radiology
275	Pancoast Henry K	Philadelphia, Pa	Radiology
276	Pawling Jesse R	Watertown N Y	Radiology
277	Peden, Joseph C	St Louis, Mo	Diagnostic Roentgenology
278	Peirce, Carleton Barnhart	Ann Arbor Mich	Roentgenology
279	Pendergrass Eugene Percival	Philadelphia, Pa	Radiology
280	Perry Gentz	Evanston Ill	Radiology
281	Peters Chester M	Canton Ohio	Radiology
282	Peterson Charles Hanson	Roanoke Va	Radiology
283	Peterson Vernon L	Charleston W Va	Roentgenology
			Radiology

Name	Address	Field
133 Habbe J Edwin	Milwaukee, Wis	Diagnostic Roentgenology
134 Hall E Walter	Detroit Mich	Radiology
135 Hankins John Logan	Johnson City Tenn	Roentgenology
136 Harding, Donnan B	Lexington Ky	Radiology
137 Harrington, Bernard D	Tacoma Wash	Radiology
138 Harris John H	Harrisburg Pa	Radiology
139 Hartung Adolph	Chicago Ill	Roentgenology
140 Hasley Clyde Knapp	Detroit, Mich	Radiology
141 Hauser, Harry	Cleveland Ohio	Radiology
142 Hawley, Sydney James	Danville, Pa	Roentgenology
143 Hay, Percy D, Jr	Florence, S C	Radiology
144 Heacock, Charles Hunter	Memphis, Tenn	Roentgenology
145 Healy, Thomas Raymond	Boston, Mass	Roentgenology
146 Heatley John E	Oklahoma City, Okla	Diagnostic Roentgenology
147 Heberding John	Youngstown, Ohio	Radiology
148 Hefke, Hans W	Milwaukee, Wis	Radiology
149 Hendricks Elliott Miley	Ft Lauderdale, Fla	Roentgenology
150 Hendrickson, Anna R	Canton, Ohio	Roentgenology
151 Henry, Lucas Smith	Syracuse N Y	Diagnostic Roentgenology
152 Herpel Frederick Karl	West Palm Beach, Fla	Roentgenology
153 Herrman William Gettier	Asbury Park N J	Radiology
154 Hill Walter Coit	Cleveland Ohio	Roentgenology
155 Hilt Lawrence Mershon	Springfield, Ill	Roentgenology
156 Hodges Fred Jenner	Ann Arbor, Mich	Radiology
157 Hodges Fred M	Richmond Va	Radiology
158 Hodges Paul C	Chicago, Ill	Radiology
159 Holly Leland E	Muskegon Mich	Roentgenology
160 Holmes, George Winslow	Boston, Mass	Radiology
161 Holmes Ralph Williams	Chillicothe, Ohio	Roentgenology
162 Howes, William Edward	Brooklyn, N Y	Radiology
163 Hubeny, Maximilian John	Chicago Ill	Roentgenology
164 Hufford C E	Toledo Ohio	Radiology
165 Hunt Howard B	Omaha Neb	Radiology
166 Hunter, James Wilson, Jr	Norfolk, Va	Radiology
167 Ikeda Kano	St Paul, Minn	Roentgenology
168 Imboden Harry M	New York N Y	Roentgenology
169 Ivey H B	Goldsboro N C.	Diagnostic Roentgenology
170 Jaches Leopold	New York N Y	Radiology
171 Jackson, Byron Hubbard	Scranton Pa	Radiology
172 Jacob Harold William	Ann Arbor Mich	Radiology
173 Jarre, Hans A	Detroit Mich	Radiology
174 Jenkinson, Edward L	Chicago Ill	Radiology
175 Johnson, Ellsworth	Winchester Va	Diagnostic Roentgenology
176 Johnson Jesse B	Galveston Tex	Radiology
177 Johnson Vincent Clifton	Ann Arbor Mich	Radiology
178 Kahn Max	Baltimore Md	Roentgenology
179 Kalbfleisch William K	Wheeling, W Va	Roentgenology
180 Kann, Ulysses S	Binghamton N Y	Radiology
181 Kaplan, Ira I	New York N Y	Therapeutic Radiology
182 Kasabach Haig Haigoumi	New York N Y	Radiology
183 Keichline John M	Huntingdon Pa	Radiology
184 Keith, David Yandell	Louisville Ky	Radiology
185 Kelly James Francis	Omaha Neb	Radiology
186 Kenning John Carl	Detroit Mich	Radiology
187 Kerby James P	Salt Lake City Utah	Roentgenology
188 Kerr, H Dabney	Iowa City, Iowa	Radiology
189 Kinney, Lyell Cary	San Diego Cal	Radiology
190 Kirklin B R	Rochester Minn	Radiology
191 Kolvoord Theodore	Battle Creek Mich	Diagnostic Roentgenology
192 Kornblum Karl	Philadelphia Pa	Radiology
193 Kuegle Frederick H	Janesville Wis	Diagnostic Roentgenology
194 Lafferty Robert Hervey	Charlotte N C	Radiology
195 Lange Sidney	Cincinnati Ohio	Radiology
196 Langer, Heinz	Pittsburgh Pa	Therapeutic Radiology
197 Larkey Charles J	Bayonne N J	Diagnostic Roentgenology
198 Lattman Isidore	Washington D C	Radiology
199 Lawrence W S	Memphis Tenn	Radiology
200 Leddy Eugene Thomas	Rochester Minn	Radiology
201 Leibert Harry F	Bethlehem Pa	Roentgenology
202 Lenz, Maurice	New York N Y	Therapeutic Radiology
203 Leonard Ralph D	Boston, Mass	Roentgenology
204 Leucutia Traian	Detroit, Mich	Radiology
205 Levi Irwin P	Anniston Ala	Diagnostic Roentgenology
206 Le Vine David	Eldorado Ark	Diagnostic Roentgenology
207 Levy n Lester	Buffalo N Y	Diagnostic Roentgenology
208 Lhevine Morris B	Tulsa Okla	Roentgenology

	Name	Address	Field
359	Swope, Opie William	Wichita, Kansas	Radiology
360	Taft, Robert B	Charleston, S C	Radiology
361	Taylor, Clifford C	Indianapolis Ind	Radiology
362	Taylor, Henry Keller	New York, N Y	Diagnostic Roentgenology
363	Taylor, Raymond G	Los Angeles, Cal	Radiology
364	Thomas, Merthyn Arthur	Cleveland Ohio	Radiology
365	Thompson Harold B	Seattle Wash	Radiology
366	Tice, Galen M	Kansas City, Kans	Radiology
367	Titterington Paul F	St Louis, Mo	Roentgenology
368	Trostler, I S	Chicago, Ill	Roentgenology
369	Troup Ralph L	Green Bay, Wis	Radiology
370	Troxell Wm Chas	Allentown, Pa	Roentgenology
371	Tyler, Albert Franklin	Omaha, Neb	Radiology
372	Ude, Walter Herman	Minneapolis, Minn	Roentgenology
373	Ulbrich, Henry L	Detroit Mich	Roentgenology
374	Upson Wilbur Owen	Battle Creek Mich	Radiology
375	Van Allen Harvey Ward	Springfield Mass	Radiology
376	Van Buskirk Edmund Michael	Ft Wayne, Ind	Roentgenology
377	Velkoff Metodi	Ft Wayne, Ind	Roentgenology
378	Virden C Edgar	Kansas City, Mo	Radiology
379	Vogt, Edward C	Boston, Mass	Roentgenology
380	Voke Edward Lawrence	Akron Ohio	Diagnostic Roentgenology
381	Von Poswik, Gisela	Scranton, Pa	Roentgenology
382	Walton, Henry Janney	Baltimore, Md	Radiology
383	Wasson, W W	Denver, Col	Radiology
384	Waters, Charles A	Baltimore, Md	Roentgenology
385	Watkins W Warner	Phoenix Ariz	Radiology
386	Weaver Clarence E	Detroit Mich	Roentgenology
387	Webb James A H	Wichita, Kans	Roentgenology
388	Weber, Harry Matthew	Rochester, Minn	Roentgenology
389	Wescott, William Carter	Atlantic City, N J	Radiology
390	West James H	Cleveland, Ohio	Radiology
391	West, Theodore	Port Chester N Y	Roentgenology
392	Whitlock, Simon Ben	Norfolk, Va	Roentgenology
393	Widmann Bernard Pierre	Philadelphia Pa	Radiology
394	Wigby Palmer E	Dallas Texas	Radiology
395	Williams, Lester James	Baton Rouge, La	Radiology
396	Willy, Ralph Gilmer	Chicago Ill	Roentgenology
397	Wilson Stanley A	Burlington Vt	Roentgenology
398	Withers, Sanford	Denver, Col	Therapeutic Radiology
399	Witwer Eldwin Roy	Detroit, Mich	Radiology
400	Wright, C S	Indianapolis, Ind	Diagnostic Roentgenology
401	Wurster Lloyd Edward	Williamsport Pa	Diagnostic Roentgenology
402	Young Barton R	Philadelphia Pa	Radiology
403	Zink Oscar Charles	St Louis, Mo	Radiology
404	Zulich, J Donald	Philadelphia Pa	Roentgenology

There will be two meetings of the Board in 1935 for the purpose of conducting examinations. The first will be in Yosemite, California, some time between May 10 and 15, and the second in Atlantic City, New Jersey, about June 8, 9, and 10. Any applicant wishing to appear before the Board in Yosemite must

have his application in the Secretary's office not later than March 1, and any one desiring to appear before the Board in Atlantic City must have his application on file by April 1.

B R KIRKLIN, M D,
Secretary-Treasurer,
The American Board of Radiology

RADIOLOGISTS-HOSPITALS COMMITTEE REPORT¹

DR E L JENKINSON (Chicago) First, I want to take this opportunity to thank a great many of the members of the Society for co-operating in bringing about this report. I want especially to thank Dr Christie and Dr Chamberlain, who were a great aid in the consummation of this report.

¹ From the minutes of the Annual Meeting, Dec 3-7, 1934.

To the President and Members of the Radiological Society of North America. Pursuant to the resolution passed at the last annual meeting of the Society, a Hospital-radiologist Committee was appointed by the Executive Committee.

This Committee has investigated the problem by circularizing many hospitals and radiologists in the United States and Canada, and by considerable study of the matter. The Committee begs to offer the following preliminary report.

Name	Address	Field
284 Pfahler, George Edward	Philadelphia Pa	Radiology
285 Phillips, Cly de Columbus	Charlotte, N C	Radiology
286 Pierce, Harold J	Terre Haute, Ind	Radiology
287 Pierson, John Wilham	Baltimore Md	Roentgenology
288 Pindell, Merl Lee	Los Angeles, Cal	Diagnostic Roentgenology
289 Pirie, Alexander Howard	Montreal Quebec	Radiology
290 Pitts Thomas A	Columbia, S C	Roentgenology
291 Podlasky, Harry Bernard	Milwaukee, Wis	Roentgenology
292 Pohle, Ernst Albert	Madison Wis	Therapeutic Radiology
293 Pomeranz Maurice M	New York, N Y	Radiology
294 Pomeroy, Lawrence A	Cleveland, Ohio	Radium Therapy
295 Portmann Ursus V	Cleveland Ohio	Radiology
296 Potter, Carlton Frasier	Syracuse N Y	Roentgenology
297 Potter, Hollis	Chicago Ill	Roentgenology
298 Potter Roy Pilling	Marshfield Wis	Roentgenology
299 Powers Martin Thomas	Utica N Y	Diagnostic Roentgenology
300 Prouty, James V	Terre Haute Ind	Radiology
301 Putts B Swayne	Erie, Pa	Roentgenology
302 Quick, Douglas	New York N Y	Therapeutic Radiology
303 Quimby A Judson	New York N Y	Roentgenology
304 Quiney, James J	Easton Pa	Radiology
305 Raap Gerard	Miami Florida	Radiology
306 Rauschenbach Charles Wm	Hammond Ind	Roentgenology
307 Ray, William Burton Getty	Pittsburgh Pa	Roentgenology
308 Reaves Hugh G	Knoxville Tenn	Roentgenology
309 Reeves Robert James	Durham N C	Radiology
310 Reineke Harold G	Cincinnati, Ohio	Diagnostic Roentgenology
311 Reitter George Stiles	East Orange N J	Radiology
312 Reynolds, Lawrence	Detroit Mich	Radiology
313 Rhinehart Darmon A	Little Rock Ark	Roentgenology
314 Rigler, Leo G	Minneapolis Minn	Radiology
315 Ritvo Max	Boston Mass	Radiology
316 Ritzman Allen Z	Harrisburg Pa	Roentgenology
317 Robins, Samuel Alexander	Boston Mass	Roentgenology
318 Robinson, Ralph V	Pittsburgh Pa	Roentgenology
319 Robinson Walter W	Memphis Tenn	Roentgenology
320 Rodgers Floyd D	Columbia, S C	Radiology
321 Rodriguez Juan	Fort Wayne, Ind	Diagnostic Roentgenology
322 Roland, Marion Mansfield	Oklahoma City, Okla.	Therapeutic Radiology
323 Rose, Cassie Belle	Chicago Ill	Radiology
324 Rosenbaum George	Philadelphia, Pa	Diagnostic Roentgenology
325 Rousseau James P	Winston Salem N C.	Radiology
326 Rowe Edward W	Lincoln Neb	Radiology
327 Rudisill Hillyer, Jr	Charleston S C	Radiology
328 Rutledge Clifford P	Shreveport, La.	Diagnostic Roentgenology
329 Rypins Edwin Louis	Iowa City Iowa	Radiology
330 Sante, L R	St Louis Mo	Radiology
331 Schmitz, Henry	Chicago Ill	Therapeutic Radiology
332 Schons Edward	St Paul Minn	Radiology
333 Sharpe, A Maxwell	Chester Pa	Roentgenology
334 Shaw, Wilfred McLaurin	Jacksonville Fla	Roentgenology
335 Sherrick, Earl C	Connellsville, Pa	Diagnostic Roentgenology
336 Shiflett E Lee	Indianapolis Ind	Roentgenology
337 Sims George P	Columbus Ohio	Therapeutic Radiology
338 Skinner Edward Holman	Kansas City Mo	Radiology
339 Smith Lester A	Indianapolis Ind	Radiology
340 Smyth Thos L	Allentown Pa	Roentgenology
341 Snow Henry	Dayton Ohio	Radiology
342 Snure, Henry	Los Angeles, Cal	Roentgenology
343 Soiland Albert	Los Angeles Cal	Radiology
344 Sosman Merrill C	Boston Mass	Radiology
345 Spangler, Davis	Dallas Tex	Radiology
346 Spencer, Hunter B	Lynchburg Va	Roentgenology
347 Spilman Harold Augustus	Ottumwa Iowa	Roentgenology
348 Spinzig Edgar Walter	St Louis Mo	Radiology
349 Sproull John	Haverhill Mass	Roentgenology
350 Stayton Chester A	Indianapolis Ind	Roentgenology
351 Steel David	Cleveland Ohio	Roentgenology
352 Steiner Joseph M	New York N Y	Roentgenology
353 Stephenson Frank Butler	Denver Col	Radiology
354 Stevens Rollin Howard	Detroit Mich	Radiology
355 Stewart William H	New York N Y	Roentgenology
356 Stone, Robert S	San Francisco Cal	Roentgenology
357 Sutherland Charles G	Rochester Minn	Diagnostic Roentgenology
358 Swenson Paul C	New York N Y	Roentgenology

	Name	Address	Field
359	Swope, Opie William	Wichita, Kansas	Radiology
360	Taft, Robert B	Charleston, S C	Radiology
361	Taylor, Clifford C	Indianapolis Ind	Radiology
362	Taylor, Henry Keller	New York, N Y	Diagnostic Roentgenology
363	Taylor, Raymond G	Los Angeles, Cal	Radiology
364	Thomas Merthyn Arthur	Cleveland, Ohio	Radiology
365	Thompson, Harold B	Seattle, Wash	Radiology
366	Tice, Galen M	Kansas City, Kans	Radiology
367	Titterington Paul F	St Louis, Mo	Roentgenology
368	Trostler, I S	Chicago Ill	Roentgenology
369	Troup Ralph L	Green Bay, Wis	Radiology
370	Troxell, Wm Chas	Allentown, Pa	Roentgenology
371	Tyler Albert Franklin	Omaha, Neb	Radiology
372	Ude Walter Herman	Minneapolis, Minn	Roentgenology
373	Ulbrich Henry L	Detroit, Mich	Roentgenology
374	Upson, Wilbur Owen	Battle Creek, Mich	Radiology
375	Van Allen, Harvey Ward	Springfield, Mass	Radiology
376	Van Buskirk, Edmund Michael	Ft Wayne, Ind	Roentgenology
377	Velkoff Metodi	Ft Wayne, Ind	Roentgenology
378	Virden, C Edgar	Kansas City, Mo	Radiology
379	Vogt, Edward C	Boston, Mass	Roentgenology
380	Voke, Edward Lawrence	Akron, Ohio	Diagnostic Roentgenology
381	Von Poswik, Gisela	Scranton, Pa	Roentgenology
382	Walton, Henry Janney	Baltimore, Md	Radiology
383	Wasson, W W	Denver, Col	Radiology
384	Waters Charles A	Baltimore, Md	Roentgenology
385	Watkins, W Warner	Phoenix Ariz	Radiology
386	Weaver, Clarence E	Detroit, Mich	Roentgenology
387	Webb James A H	Wichita, Kans	Roentgenology
388	Weber, Harry Matthew	Rochester, Minn	Roentgenology
389	Wescott, William Carter	Atlantic City, N J	Radiology
390	West James H	Cleveland, Ohio	Radiology
391	West, Theodore	Port Chester N Y	Roentgenology
392	Whitlock, Simon Ben	Norfolk, Va	Roentgenology
393	Widmann, Bernard Pierre	Philadelphia, Pa	Radiology
394	Wigby Palmer E	Dallas, Texas	Radiology
395	Williams Lester James	Baton Rouge, La	Radiology
396	Willy Ralph Gulmer	Chicago Ill	Roentgenology
397	Wilson, Stanley A	Burlington, Vt	Roentgenology
398	Withers, Sanford	Denver, Col	Therapeutic Radiology
399	Witwer Eldwin Roy	Detroit Mich	Radiology
400	Wright C S	Indianapolis, Ind	Diagnostic Roentgenology
401	Wurster Lloyd Edward	Williamsport, Pa	Diagnostic Roentgenology
402	Young Barton R.	Philadelphia, Pa	Radiology
403	Zink Oscar Charles	St Louis Mo	Radiology
404	Zulick J Donald	Philadelphia Pa	Roentgenology

There will be two meetings of the Board in 1935 for the purpose of conducting examinations. The first will be in Yosemite, California, some time between May 10 and 15, and the second in Atlantic City, New Jersey, about June 8, 9, and 10. Any applicant wishing to appear before the Board in Yosemite must

have his application in the Secretary's office not later than March 1, and any one desiring to appear before the Board in Atlantic City must have his application on file by April 1.

B R KIRKLIN, M D,
Secretary-Treasurer,
The American Board of Radiology

RADIOLOGISTS-HOSPITALS COMMITTEE REPORT¹

DR E L JENKINSON (Chicago) First, I want to take this opportunity to thank a great many of the members of the Society for co-operating in bringing about this report. I want especially to thank Dr Christie and Dr Chamberlain, who were a great aid in the consummation of this report.

¹ From the minutes of the Annual Meeting, Dec 3-7 1934.

To the President and Members of the Radiological Society of North America. Pursuant to the resolution passed at the last annual meeting of the Society, a Hospital-radiologist Committee was appointed by the Executive Committee.

This Committee has investigated the problem by circularizing many hospitals and radiologists in the United States and Canada, and by considerable study of the matter. The Committee begs to offer the following preliminary report.

1 The practice of radiology is the practice of medicine and is no more a part of the corporate activity of a hospital than is any other branch of medical practice. Radiologists are subject to the same Code of Ethics as other members of the American Medical Association, and hospitals should be bound by the same Code of Ethics in their relation with radiologists.

2 The hospital has a right to an adequate and fair return for obsolescence on x-ray equipment, rental for space occupied and charges for heat, light, water, telephone and janitor service, and similar expenses.

3 The hospital is not entitled to any part of the net return from the professional services of the radiologist.

4 To assure an equitable return to the hospital and an equitable status to the radiologist on its staff, a rental type of appointment would appear to be the simplest and most effective. By this is meant that the radiologist would rent space, or space and equipment, from the hospital, paying the latter a monthly sum, this rent to be based on the factors mentioned above (see Section 2).

5 The rental type of appointment is believed to be the most equitable one, both for the hospital and for the radiologist. However, your Committee realizes that many radiologists and hospitals are operating under a percentage or salary agreement. Under these circumstances, the above-stated ethical principles should become operative at the earliest possible moment. Under existing arrangements it is of especial importance that the radiologist should have complete charge of the department including the fixing of fees, the control of personnel, and the submission of bills to patients on his own personal bill-head, whether this be done by himself or by the hospital.

6 An Arbitration Committee should be formed in each community consisting of one or two hospital executives, one or two radiologists and one or two general physicians or surgeons. It would be the duty of this committee, in case of dispute, to settle such questions as the amount of space needed for the department, the necessity for replacement of equipment, the rental to be charged, and similar questions.

7 Your Committee believes that the practice of radiology in hospitals should be in the hands of the physician and that the responsi-

bility of employing and discharging technicians, determining fees, and rendering and collecting bills should be his.

8 It is recognized that the hospital has authority through its executive medical staff, to terminate the appointment of its radiologist on reasonable grounds and after due notice, similar grounds and notice being open to the radiologist should voluntary resignation be advisable.

9 In hospitals wherein all members of the staff are on salary or where all members are compensated in some manner other than that outlined above, it is obvious that the radiologist should be compensated in the same manner as his medical *confrères*.

10 Since the personal relation between the patient and his doctor is fundamental in medical practice, any plan that tends to prevent such is detrimental to radiology. Therefore, we believe that radiologists' services should not be included in any flat rate or group hospitalization plan. We wish further to emphasize the dangers of the artificial division of the x-ray examination into so-called technical and professional portions. It is our conviction that the integrity of radiology cannot be maintained under such division.

11 Your Committee believes that adherence to the above-outlined principles is the only method which will insure to patients and hospitals the maintenance of radiology on the high level commensurate with their best interests.

12 Your Committee recommends that a copy of this report be sent to the American Roentgen Ray Society, the American College of Radiology, the American Radium Society, and the Section on Radiology of the American Medical Association, with a request for concurrence in the plan as outlined, and that copies should be sent to such other persons as individual members may wish.

13 The investigation of your Committee reveals the necessity for solidarity and co-operation not only of radiologists but of all branches of the medical profession, for the solution of the important economic problems before us, and therefore we recommend the formation of a national Radiological Economics Committee to be made up of two representatives from each of the radiological societies.

Your Committee is of the opinion that greatest progress in the settlement of the hospitals-radiologists problem will be made

only by national agreement on a plan embodying fundamental principles in which all radiologists concur

14 Your Committee recommends, therefore, that the Executive Committee of the Radiological Society of North America be instructed to take such steps as may be necessary to bring about the formation of the inter-society committee recommended in this report

COMMITTEE ON RADIOLOGISTS AND HOSPITALS

REPORT OF COMMITTEE ON INSURANCE¹

Your Committee on Insurance presents the following report

The second paragraph of the report of this Committee presented Sept 25, 1933, at Chicago, read

The premium rates on medical malpractice insurance to roentgenologists have been increased in several States by insurance companies which have been furnishing this insurance at reduced rates in these States

Since the presentation of that report, your Committee on Insurance is privileged to report a much more pleasing situation. Due to and in a large measure because of the continued activity of this Committee, a decidedly worthwhile reduction in malpractice insurance premiums has been made by one of the best of our insurance carriers, one in which a large number of our members carry their insurance

In the States of Illinois, Indiana, Iowa, Kansas, Michigan, Ohio (except only the northern part), Pennsylvania, and Wisconsin there has been a reduction of 40 per cent from previous rates for malpractice insurance for radiologists using the roentgen rays for therapeutic purposes, and of 70 per cent for those using the roentgen rays for diagnosis only

In northern Ohio the reduction is not quite so much but it is still a considerable amount less than formerly

In the States of Missouri (except one county) and Texas this same insurance carrier has reduced the premium rate for radiologists doing roentgentherapy from \$90 to \$68 for the 5,000-15,000 contract and to \$29 per year for those not doing therapy

Relatively similar reductions, particularly those who are not doing roentgentherapy, have

been made in other States, and these reductions in the premium rates have resulted in a saving of thousands of dollars to our members

The usual number of members have made inquiries and have asked questions from the Chairman of this Committee, and we trust were satisfied with the replies

It was recommended that the 1933 report of this Committee be published in *RADIOLOGY* and a motion was passed that that recommendation be approved so that the members of this Society might be informed as to the activities of the Society in this particular, but that report has not yet been published. This Committee now recommends that the Committee on Insurance be continued and that the Editor of *RADIOLOGY* be directed to publish this report in the earliest possible number of that publication

Respectfully submitted by the Committee on Insurance,

I S TROSTLER, *Chairman*

COMMUNICATIONS

SHOULD THE PATIENT BE TOLD?

FURTHER COMMENT

In the December, 1934, issue of *RADIOLOGY* appeared an editorial by Dr Orville N Meland with the above title. An appended footnote by the Editor invited further expressions of opinion on this subject. The following excerpt from a book entitled "Cancer A Professional Responsibility and a Public Liability," by Albert Soiland, M D, published in 1927 by D Appleton & Co, is significant

"Nowhere in the practice of medicine is the responsibility of the physician to the public greater than in the field of cancer. He must first be sure that he is dealing with cancer and this can usually be easily determined by modern diagnostic methods. Next, the patient must be made aware of the serious nature of the disease, and this must be done in the proper way and without any unnecessary shock. There are, of course, many individuals whom it might be wise not to inform of their condition. In such cases those nearest the patient must know about it. There are many situations which tax the skill and diplomacy of a physician but he would not be true to his calling or his duty to humanity if he did not

¹ Annual Meeting Memphis Tenn Dec 3-7, 1934

impart the right kind of information to those who should and must know it. If the disease is localized and in a location where it can be removed, with a good prospect of relief, and without immediate danger to the life of the patient, he or she can be freely assured of this fact. If, on the other hand, a person apparently in general good health is found to be harboring a cancer which has already invaded the interior structures, proper handling of this problem taxes the ingenuity and resourcefulness of the physician. It is no easy task to approach the apparently healthy individual and inform him that an active cancer is present in a form which will make successful treatment not only doubtful but useless. When an apparently normal individual walks into your examining room in seemingly good health, and you find an advanced cancer, and know that this patient cannot live more than a few months, the problem is pitifully complex. Yet despite this, it appears to be the solemn duty of the physician to inform such a patient or his nearest relatives that he must prepare his personal affairs to meet the inevitable end. This is indeed a grave responsibility and is one of daily occurrence with the physician whose practice brings him into contact with major cancer work." (Chapter VIII)

Dr. Soiland makes a vitally important point, or so it seems to the Editor, in advising that the patient's nearest relatives shall be told, in case there appears to be valid reason for withholding from the patient himself knowledge of the true nature of his affliction.

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DR. LEWIS STEPHEN PILCHER

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In 1884 he became editor of the "Annals of Surgery," which position he occupied to the end of his life. The editorial policy of that journal and the censorship of its advertising

were never relinquished by the Editor. If we add to the fifty years of the "Annals of Surgery," the seven years of the "Annals of Anatomy and Surgery," and its predecessor which he inspired and dominated, this period of medical editorship establishes Dr. Pilcher as the dean of medical editors in the United States, if not in the world.

MINNESOTA RADIOLOGICAL SOCIETY

The fall meeting of the Minnesota Radiological Society was held at Rochester, Minnesota, Oct. 13, 1934. The program was presented by the staff of the Mayo Clinic and was as follows:

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 - 2 Backache R. K. Ghormley, M.D.
 - 3 Interesting Diagnostic Problems J. D. Coate, M.D.
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 - 6 Osteoporikilosis and Allied Diseases of Bone C. G. Sutherland, M.D.
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 - 8 The International Congress of Radiology at Zurich and St. Moritz A. U. Desjardins, M.D.
- Address: Some Effects of Radiation C. Sheard, M.D.

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Meetings are held the fourth Wednesday of the month.

FLORIDA STATE RADIOLOGICAL SOCIETY

The Meeting of the Florida State Radiological Society was held on Oct. 27, 1934, in St. Petersburg, Florida. The Society was the guest of Dr. Stevens of the United States Veterans Hospital.

The following officers were elected for the coming year Frederick K Herpel, M D, *President*, W McL Shaw, M D, *Vice-President*, Frazier J Payton, M D, *Secretary-Treasurer*

The meeting consisted of a morning session—a round-table discussion of interesting and problematical cases The afternoon session consisted of a symposium on radiation therapy led by Dr Cunningham, of Jacksonville, Florida The radiologists attended dinner together at the Seminole Club, St Petersburg Dinner was followed by an evening session, devoted to economics

THE XI ITALIAN CONGRESS OF MEDICAL RADIOLOGY

PERUGIA SEPT 20 22 1934

The XI Congress of the Italian Society of Medical Radiology, which was founded twenty-two years ago and whose membership amounts at present to about five hundred, was held in Perugia, where it developed its work, and was attended by a large number of persons interested in that science The work carried out was of great importance and the subjects treated particularly interesting, as, for instance—

- (1) Traumatic affections and lesions of the spinal column (Prof Lapenna),
- (2) Radiotherapy of the encephalos (Prof Palmieri),
- (3) Radiotherapy of the peripheric nervous system (Prof Del Buono),
- (4) Radiotherapy of the sympathetic nerve,
- (5) Modern methods of radiologic research (Prof Benassi and Prof Perone)

More than two hundred communications, most of which concerned the subjects treated in the Reports, were filed, and the discussions occasioned thereby proved of the greatest interest

The General Assembly of the Members of the Society, which was held at the same time, gave the opportunity of taking into consideration a number of important questions such as the Teaching in the Universities, Hospital Service, and Private Practice in Connection with the New Corporative Dispositions

The Board of Directors for the previous two years was confirmed under the Presidency of Prof Siciliano, of Florence Venice was voted by acclamation as the seat of the XII Congress, under the Presidency of Prof Vespignani

BOOK REVIEWS

RÖNTGEN GANZAUTNAHMEN DES MENSCHEN (TOTAL ROENTGENOGRAMS OF MAN) VIEWS OF THE NORMAL SKELETON, ITS HEREDITARY AND ACQUIRED CHANGES By DR ROBERT JANKER, Privatdozent at the University of Bonn, with a Foreword by PROF DR E VON REDWITZ, of Bonn With 40 illustrations and one stereo-picture Published by J A Barth, Leipzig, 1934 Price, Rm 65

Only in Germany, probably, could an atlas of this character be produced in book form and in such an elaborate manner—such excursions into narrow fields appear to be economically impossible for the publishers of other countries The author presents here the results of laborious experiments in the production of single roentgenograms of the entire body by a method which differs radically from that recently attempted in this country The text is short and reasonably well translated into readable English, as are the captions of the forty-one full-page plates The German and English versions appear in separate columns side by side

Single films of sufficient size to more than cover the entire body were used A tube-focus distance of 450 cm was necessary to minimize the distortion, which would naturally be very great for an object of such large size To attain detail with reasonable speed at such a distance required rather unusual tubes The production of an even density for a single exposure which included phalanges and pelvis was accomplished by the use of a lead screen interposed for varying portions of the exposure over the thinner portions In addition, by the exercise of great care during development, the use of reducing solutions, and other punctilious attention to detail, a fairly satisfactory result was achieved The plates show, in fact, rather good soft tissue detail

It is obvious from the description of the technique that the method is of no practical importance in everyday practice, yet for research in anatomy, for anthropological studies, and for teaching purposes the procedure may have great value

In the plates, which are reproduced in remarkably fine fashion, are shown various types of normals and a number of examples of generalized bone diseases, such as chondrodystrophy, dwarfism, multiple benign cartilaginous exostoses, osteopsathyrosis, rachitic changes, and other diseases of like character One case of osteitis deformans illustrates well the compara-

impart the right kind of information to those who should and must know it. If the disease is localized and in a location where it can be removed, with a good prospect of relief, and without immediate danger to the life of the patient, he or she can be freely assured of this fact. If, on the other hand, a person apparently in general good health is found to be harboring a cancer which has already invaded the interior structures, proper handling of this problem taxes the ingenuity and resourcefulness of the physician. It is no easy task to approach the apparently healthy individual and inform him that an active cancer is present in a form which will make successful treatment not only doubtful but useless. When an apparently normal individual walks into your examining room in seemingly good health, and you find an advanced cancer, and know that this patient cannot live more than a few months, the problem is pitifully complex. Yet despite this, it appears to be the solemn duty of the physician to inform such a patient or his nearest relatives that he must prepare his personal affairs to meet the inevitable end. This is indeed a grave responsibility and is one of daily occurrence with the physician whose practice brings him into contact with major cancer work." (Chapter VIII)

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 J E HABBE M D, of Milwaukee, Wisconsin
 H W HEFKE M D of Milwaukee Wisconsin
 E T LEDDY, M D, of Rochester, Minnesota

DAVIS H PARDOLL, M D, of Chicago
 E A POHLE, M D Ph D of Madison, Wisconsin
 CHARLES G SUTHERLAND, M D, of Rochester, Minnesota

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tive lack of detail which is probably inherent in the method, although the general changes in form are very well brought out

The last plate represents a stereoscopic view of a skeleton apparently made by a more indirect method. The author describes this as a small photograph of the image of the skeleton produced on a roentgenoscopic screen of full body size. While the detail is not so good, he believes, yet this method may prove to be of more practical import because it is much less expensive. Unfortunately, details of this type of procedure are not given

OUT OF THE TEST TUBE By HARRY N HOLMES, PH D, Professor of Chemistry at Oberlin College, and Past Division Chairman of the American Chemical Society. A volume of 373 pages and 83 figures. Published by Ray Long and Richard R. Smith, Inc., New York City, 1934. Price, \$3.00

This is a most interesting account of recent advances in chemistry, together with their effects on civilization, and on the lives of all of us

There is not much that will be new to the man who each week follows the progress of science and chemical industry in journals such as "Science News Letter," the "Scientific American," "Science," or "Fortune," but to the man who has not taken the time to keep informed as to how manufacturers developed duco, bakelite, rayon, cellophane, indigo, arti-

ficial rubber, methanol, acetylene, pyrex glass, duralumin, shatterproof glass, aniline dyes, neon signs, ethyl gasoline, artificial nitrates, etc., the book will be a mine of interesting information. It will give the reader not only a review of recent progress in, let us say, steel making, but it will take him back to ancient Egypt, where on the wall of a tomb he can see slaves working a series of bellows while the foundryman tends his little furnace

The radiologist will be interested in Chapter XII on "The Fall of the House of Uranium," with its brief account of the discovery of radioactivity

This should be a splendid book for the factory executive who has not yet learned that continued success in manufacturing must be based on constant research and the application of new discoveries in science. It is a fine book, also, for a boy or for anyone who wishes to be abreast of the times

It is unfortunate that men and women to-day who use the automobile, the telephone, and the radio have not the remotest idea of what is under the hood or in the case. They do not know anything of the years of research that produced the nitrogen-filled lamp or the Coolidge tube, and they do not care to know. As a result, with their votes some day they may pass laws that will strike at the very foundations of all research and all advance in civilization, and because of their greed and ignorance they will kill the goose with the golden eggs

THE ELBOW

Patella of the Elbow A Contribution to Anomalies of the Skeleton Kurt Kremser *Röntgenpraxis*, June, 1934, 6, 371-374

The anatomical anomaly of a so-called sesmoid of the elbow or patella of the elbow has been described in only about ten instances Trauma may be excluded when the olecranon process is entirely intact The case reported by the author showed a large patella like sesmoid proximal to the olecranon and apparently in the tendon of the triceps, there was a definite distinction between cortex and medulla The bone was palpable and movable To explain this anomaly on a traumatic basis seems not correct The author believes that not only ossification in the tendons may explain this occurrence but also the formation of a true sesmoid

H W HEFKE, M D

GENITO-URINARY TRACT (DIAGNOSIS)

Neglected Affections and Lesions of the Deep Urethra Edgar G Ballenger, Omar F Elder, and Harold P McDonald *Am Jour Surg*, August, 1934, 25, 201-210

Attention is directed to the importance of more careful and well timed studies of the prostatic urethra The symptoms of disorders in this area are numerous but often are misleading, they are of value in directing to investigations which result in correct diagnoses

The diagnosis is not difficult if studies are made with a good urethroscope

If employed with reasonable skill and cystoscopic dexterity, the treatment of chronic affections and lesions of the deep urethra is generally quite satisfactory

The high frequency current cutting and fulgurating, and topical applications are the agencies usually employed

DAVIS H PARDOLL, M D

The Clinical Value of Bladder Pressure Estimations Kenneth H Watkins *British Jour Urol*, June, 1934, 6, 104-118

Observations upon the pressure within the normal urinary bladder are recorded Two different types of bladder paralysis have been demonstrated as the result of pressure studies Definite information upon the condition of the bladder innervation can be obtained by making careful pressure estimations It is pointed out that most of this information can be derived by more simple clinical means

DAVIS H PARDOLL M D

Pre sacral Sympathectomy and the Urinary Bladder E D'Arcy McCreagh and A D McDonald *British Jour Urol* June 1934 6, 119-127

The sympathetic and parasympathetic nerves function together in the regulation of the bladder and the parasympathetic are by far the more important. While the action of one or the other may be predominantly *excitor inhibitor* yet it is not to be assumed that either is exclusively so nor yet that they

are antagonists Both nerves transmit sensory impulses the pathway by the pelvic nerves being the more important The precise action of the hypogastric nerves on the vesical sphincters is not known nor is it known that the former have any influence at all upon them

DAVIS H PARDOLL M D

A Review of 162 Consecutive Personal Cases of Stone in the Upper Urinary Tract H P Winsbury-White *British Jour Urol*, June, 1934, 6, 142-155

The author reviews 162 consecutive cases of stone in the upper urinary tract, and cites his personal experience with this large series The chief interest of these cases is the manner in which they illustrate the value of intravenous pyelograph in differentiating between the various lesions When a perinephric abscess produces pressure on the upper end of the ureter, the radiologic appearance may be somewhat similar, but there is no deformity of the intrarenal portion of the pelvis unless there is some renal focus

DAVIS H PARDOLL, M D

GYNECOLOGY

Experience with Short Wave Therapy in Gynecology, Particularly in Tumors of the Adnexa E Vogt *Strahlentherapie*, 1934, 51, 526

The author used short electric waves in the treatment of acute and chronic type of peritonitis, salpingitis, and also in gonorrheal infections The results were very encouraging A most striking cure was obtained in a patient with severe gonorrheal arthritis in the knee which healed with complete function

ERNST A POHLE, M D, Ph D

HIP JOINT

Fractures of Neck of Femur, Dislocations of Hip, and Obscure Vascular Disturbances Producing Aseptic Necrosis of Head of Femur D B Phemister *Surg, Gynec and Obst*, September 1934, 59, 415-440

The vascular anatomy and the lack of collateral circulation about the hip is such that certain types of injury may, by damage of blood vessels, result in aseptic necrosis of a part or of all of the head of the femur This is closely associated with non union of the fracture, as shown by the author's statistics

In the author's experience it has been possible to determine from roentgenograms in from two to five months in the great majority of cases, especially of non union, whether the head has remained alive or has undergone partial or complete necrosis This is based on the fact that in case of non union atrophy of disuse of the living bone develops during the period of immobilization, while the dead bone of the head does not atrophy Roentgenograms made after an interval of from two to three months will show the necrotic bone to be relatively more dense than the surrounding atrophied living bone

It has been shown that connective tissue and blood vessels slowly invade the dead bone, which is then ab-

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BONE DISEASES (DIAGNOSIS)

Osteogenesis Imperfecta Report of Two Cases Samuel Kleinberg Jour Bone and Joint Surg, October 1934 16 953-958

The author presents two cases of osteogenesis imperfecta representing respectively, the congenital and the post-natal varieties of this condition. While the primary cause of the disease is unknown it is believed that the chief change in the bone is a lack of complete development of the various constituents of bone tissue.

The first patient was an infant two months old who presented deformities of all the extremities resulting from fractures present at birth. The family history was negative for evidence of a similar malady. Roentgenographic examination of the entire skeleton revealed abnormal thinness of all the bones, with evidence of deformities due to healed fractures. The cortex appeared thin and the bone lamellae atrophic and sparse. Therapy was directed to the correction of the deformities, combined with the administration of viosterol, halibut-liver oil and ultra-violet radiation. In spite of very careful medical attention the child died of pneumonia at the age of five months.

The second case was first seen by the author when the patient was two years of age. This was a case of osteogenesis imperfecta tarda which is also known as osteospathyrosis or fragilitas osseum. Medical advice was sought because of inability to walk and susceptibility to fractures from insufficient causes. The family history revealed that the patient's father at the age of 12 years had sustained a fracture of his left elbow following a sufficient injury. At various times following this he suffered six fractures of the same elbow without sufficient injury. The father and the mother of the patient had strong suggestions of blue sclera. Physical examination of the patient revealed deep china-blue sclera and outward bowing of the legs. Roentgenograms revealed marked thinning, general atrophy and increased radiability of the bones. The bone lamellae appeared thin, delicate, and sparse. The tibiae showed evidence of healed fractures. Blood chemistry revealed normal findings for calcium, phosphorus and

phosphatase, and the Wassermann test was negative. Therapy was directed to guarding him from injuries, and ultra-violet light treatment and viosterol were administered with the hope of increasing the resistance of his bones. He suffered fractures of the right and left tibiae while under treatment, but they healed rapidly and completely.

J. N. ANÉ, M.D.

CALCULI

Sialolithiasis of the Maxillary Glands Quintino Vischia Arch di radiol, 1934, 10, 262-270

Vischia presents clinical notes and the radiographs in three cases of salivary gland calculus, in all of which pain came on with the taking of food.

E. T. LEDDA, M.D.

DIAPHRAGMATIC HERNIA

Two Cases of Diaphragmatic Hernia J. S. Beilm Röntgenpraxis, April, 1934 6, 229-233

A very large left sided diaphragmatic hernia is the first case described with the entire stomach and part of the colon in the left thorax. There was no clinical symptom pointing to the lesion. The etiology was traumatic.

The second case is that of a right sided hernia with partial displacement of the liver into the right thorax. This condition is rare. The patient had some dyspnea and pain in the right thorax after an automobile accident. Roentgen examination showed portions of the colon and liver above the diaphragm.

H. W. HEFKE, M.D.

DOSAGE

The Radiotherapeutic Significance of Epitheliolysis with Special Consideration of the Oral, Pharyngeal and Laryngeal Carcinomas J. Borak Strahlen therapie 1934, 51, 480

The author discusses at length the therapeutic principles underlying the protracted fractional dose method of Coutard. He objects to the term "radio-epithelitis" which implies an inflammation of the epithelium. As Rost has stated many years ago, there can be no inflammation of the epithelium of the skin because of the absence of blood vessels. The term "radio-epitheliolysis" is suggested in its place as well as the term "radio-epitheliolytic dose." If single doses do not exceed 300 r per field, it is not necessary to protract simple fractional application at about 20 r per minute is permissible. Skin tests on a patient (photographs shown in the article) bear out the author's contention. During the period 1924-1927, twelve cases of carcinoma of the larynx, eight cases of carcinoma of the tonsil, and eleven cases of carcinoma of the oral cavity and pharynx were treated accordingly. Of the cases receiving epitheliolytic doses, 88 per cent became free from symptoms and 63 per cent remained free from recurrence for over a year.

ERNST A. POHLE, M.D., Ph.D.

A bulging in the flank was noted in all. Since perinephritic abscess so frequently accompanies carbuncle of the kidney (87.5 per cent in this series) it is incumbent upon the surgeon when operating for a perinephritic abscess to carefully explore the kidney in order to rule out a possible co-existing carbuncle.

The lesion is usually produced by an organism of attenuated virulence of the staphylococcus group. Extreme conservatism is indicated in treating these cases. The procedure of choice, as noted in this series of eight cases, is simple incision and drainage. Nephrectomy should be reserved only as a procedure of last resort.

Wound debridement has proved an extremely valuable means of curtailing post-operative convalescence. The prognosis is good especially when intervention is instituted early.

DAVIS H. PARDOLL, M.D.

Wilms Tumor of the Kidney. Samuel J. Sinkov, Major F. Fowler and Louis Berger. *Am Jour Surg*, July, 1934, 25, 163-169.

The authors wish to emphasize certain facts in connection with their case, which verify the findings of other clinical investigators. A diagnosis should be made as early as possible and proper therapy immediately instituted. Recognition of renal pathology due to neoplastic involvement is not difficult with the aid of a complete urologic study. Early operative interference offers the best prognosis. If the tumor is found to encroach upon adjacent vital structures, the outlook is not favorable, due to surgical shock and frequency of recurrence. The curative value of the x-ray and radium is questionable when they are used alone, however in conjunction with surgery, they may be of considerable value.

DAVIS H. PARDOLL, M.D.

THE LUNGS

The Diagnosis and Treatment of Pulmonary Abscess in Children. David T. Smith. *Jour Am Med Assn*, Sept 29, 1934, 103, 971-974.

Pulmonary abscess is not diagnosed as frequently in children as in adults probably because it occurs less commonly and is more difficult to differentiate from other pulmonary infections. Among 2,260 cases of lung abscess collected from the American literature, only 59 were in infants and children. Among 2,119 patients admitted to the pediatric service of the Duke Hospital seven had pulmonary abscess. Thirty-nine cases collected from the literature have been analyzed for predisposing causes supplemented by six previously reported from the Duke Hospital. Twenty-four followed pneumonia, 13 followed tonsillectomy, one followed aspiration of a foreign body, one followed exposure, and one followed aspiration of a membrane in a case of Vincent's angina.

There are four possible routes by which the infecting material may reach the lung. It may be introduced directly by a penetrating wound, it may drain in through the lymphatics, it may enter through the blood stream as an embolus, or it may be aspirated.

Cutler and his co-workers believe that most, if not all, of the abscesses following operations are embolic in origin. Certainly those following aspiration of a foreign body must reach the lungs through the air passages and those which follow pneumonia are logically explained by the same mechanism. Abscesses that follow operation in sterile fields, which remain sterile, are best explained by the aspiration of infected material while the patient is under an anesthetic. It is Cutler's opinion that the majority of cases which follow operations on the tonsils and other structures in the upper respiratory tract are also due to simple aspiration.

In children, as in adults, pulmonary abscesses can be divided on the basis of etiology into (1) bacterial abscesses, (2) fusospirochetal abscesses, and (3) fungous abscesses. As a rule the bacterial abscesses are not gangrenous while the fusospirochetal abscesses, whether diffuse through one or more lobes or limited to a small area in one lobe, are always gangrenous. The common bacteria that produce abscesses are staphylococci, Friedlander's bacilli, certain streptococci, *Bacillus pyocyaneus*, *Bacillus influenzae*, and the members of the gas gangrene group of bacilli. The source of the mixture of organisms which is responsible for the fusospirochetal type of abscess is generally the gums or the tonsils of the patient, although occasionally it may be contracted from another individual.

The history, physical signs, and x-ray shadows may be identical in cases of bacterial abscess, fusospirochetal abscess, and mycotic abscess. The final diagnosis rests entirely on a study of the pulmonary secretions. Exploring the lung with a needle in search of an abscess is contra-indicated because of the danger of producing empyema.

The general supportive measures, such as rest in bed, forcing of fluids, high vitamin diet, and postural drainage can be equally well applied to all types of pulmonary abscess. Bacterial abscess of the gas gangrene group should be treated with specific or polyvalent antigangrene serums. The acute staphylococcal abscesses might be treated with new staphylococcus antitoxin. Abscesses due to other bacteria should be treated palliatively in the acute stage unless empyema develops. If the lesion persists for three months, it has reached the chronic stage and should be treated by open operation and drainage. The fusospirochetal type should be diagnosed and arsenic treatment started within the first two weeks if the best results are to be obtained.

The mycotic abscesses of the lung should be treated by gradually increasing doses of potassium iodide.

CHARLES G. SUTHERLAND, M.D.

Syphilitic Gumma of the Lung. Case Report. Eugene Freedman and Charles S. Higley. *Am Jour Roentgenol and Rad Ther*, March, 1934, 31, 333-339.

Referring to a recent review of the literature, the authors state that between the years 1854 and 1920 only 48 cases of pulmonary syphilis with autopsy verification have been reported in the literature.

The patient, a woman of 36 years of age, was ad-

sorbed and replaced by new bone by the process of "creeping substitution." This process may take place over a period of months or years.

Traumatic dislocation of the hip severs the round ligament, which in some cases contains blood vessels supplying a portion of the head of the femur. This portion of the head undergoes aseptic necrosis unless there is an adequate collateral circulation in this region. If too extensive weight bearing is allowed in these cases before the process of creeping substitution is completed, collapse of the head and permanent lameness of the hip result. The author reports one case each of necrosis and collapse of the head of the femur following fracture of the base of the neck with bone union and fracture of the greater trochanter. Other conditions in which aseptic necrosis occurs are as follows: Slipped femoral epiphyses during adolescence or late childhood, pathologic dislocations of the hip, congenital dislocations of the hip that are reduced by manipulation or operation, arthroplasty for the mobilization of ankylosed hips, Perthes' disease, and osteochondritis dissecans. Aseptic necrosis has been noted also in adults in whom there is no history of an etiologic factor. Causative factors that have been considered are trauma, embolism, obliterative vascular disease, constitutional and endocrine disturbances.

J N ANÉ M D

THE INTESTINES

Benign Stricture of the Intestine Due to Irradiation of Carcinoma of the Cervix Uteri. E N Collins and Thomas E Jones. Surg., Gynec. and Obst., October, 1934, 59, 644-649.

The authors present six cases of benign stricture of the intestine which occurred in a series of 422 patients with cervical carcinoma treated by irradiation therapy. The recognition of this condition as a clinical entity is of great importance for this curable lesion may be easily mistaken for metastatic carcinoma.

Five of the six cases of this group had received both radium and roentgen therapy and one patient had had only radium therapy. In all cases tubes of radon having 1.5 mm of brass filtration enclosed in 2 mm of rubber were used and the dose administered varied from 2440 to 4240 millicurie-hours. Roentgen therapy was administered through four portals—suprapubic, right ilio-pubic, left ilio-pubic and post sacral. Each portal received 50 per cent of a skin dose at a time, and the entire course in each case was given in from 5 to 7 days. The factors employed were 200 K.V. from 5 to 8 ma., filtration from 0.5 to 1.0 mm of copper and 1 mm of aluminum, focal skin distance, 50 centimeters. The skin unit dose was 800 r, the estimated 10 cm depth dose was from 30 to 40 per cent and the total calculated roentgen dose about the cervix was approximately 800 r.

The lesion found in these cases consisted of a localized annular, fibrous thickening of the wall of the intestine associated with a varying constriction of the lumen. It is believed that ulceration may or may not

be present at the time the lesion is observed at operation.

The history of unusual intestinal symptoms such as tenesmus, diarrhea, mucus and blood in the stools for a period of three weeks or longer immediately following irradiation therapy, is considered of significance in the diagnosis of this condition. With the formation of the stricture the patient complains of unusual constipation, followed by symptoms of intestinal obstruction. Because of the fixation by adhesions of the involved segment it may be impossible to examine the lesion by means of the sigmoidoscope. The colon roentgen examination is considered the most important single means of revealing the condition. An annular filling defect, somewhat similar to the appearance of an infiltrating carcinoma, is noted if the obstruction is not complete. However, in the case of the benign stricture the defect is hour glass in appearance, and although small, is fixed in position and presents a more gradual line of demarcation between the normal and abnormal tissue than is usually seen in malignancy.

Since it is believed that irradiation stricture may develop in a localized segment of intestine because this segment, during radium irradiation, remains constantly adjacent to the area being treated, the lesion should be prevented if the position of this segment can be changed at intervals during the time the radium is in place. The authors advise, therefore, changing the position of the patient at intervals from the usual horizontal to the Trendelenburg position when the radium is placed high in the fundus. During the cervical application the moderate Trendelenburg position should serve to separate the intestine sufficiently from the radium. The use of pitressin administered after the usual thorough emptying of the intestine to stimulate continued intestinal peristaltic activity, and the colon tube to prevent the accumulation of gas, are also suggested.

J N ANÉ M D

THE KIDNEYS

Carbuncle of the Kidney. Joseph A Lazarus. Am Jour Surg. July 1934 25, 155-162.

The author reports eight cases of carbuncle of the kidney. In his series five occurred in females. He draws the following conclusions:

Carbuncle of the kidney is a distinct clinical entity. In 75 per cent of the cases the right kidney was involved.

A history of pain and tenderness in the lumbar region, accompanied by fever and loss of weight with a scarcity of urinary symptoms especially when following a carbuncle or furuncle elsewhere in the body, is extremely suggestive of this condition.

Cystoscopy offers little aid in diagnosis. Roentgenologically an effacement of the psoas margin with an enlargement of the renal silhouette on the affected side is very suggestive of this disease. Absence of the psoas margin was noted in all cases of this group while an enlarged renal silhouette was seen in 50 per cent of them.

in the opinion of the authors, just about what can be accomplished by roentgen therapy

Histologic changes occurring in the hypertrophied prostate are numerous and varied, of which lymphocytic infiltration, congestion and edema, and smooth muscle tissue and epithelial overgrowth are unstable factors which might respond to radiation therapy

In most instances the patient was studied to determine accurately the amount of residual urine, then treated by catheterization irrigation, massage, and internal medication to the point of maximum benefit, after which he was referred to the roentgenologist to determine how further improvement could be accomplished by him. Ordinarily three fields were used suprapubic, perineal and sacral, about 200 r being given to one portal every other day until the three portals had each been irradiated once then at about ten day intervals. A second third and even fourth series may be given. Since the accumulated depth dose is only about 34 per cent of an erythema dose, per cycle, it is believed that beneficial results are primarily due to decrease and control of the edema in the gland. It also seems probable from study of the good results achieved in this group of cases that the 'simple bilateral lobe hypertrophy' described by Randall is the type best suited to this form of treatment

J E HABBE, M D

RADIATION EFFECTS

Fundamental Principles of Pre-operative Irradiation
O Jüngling *Strahlentherapie* 1934, 51, 393

The author discusses briefly the indications for pre-operative irradiation as practised in his clinic. He feels that pre-operative exposure of a tumor is not only a therapeutic but also a diagnostic method since it offers an opportunity to determine the radiosensitivity of a neoplasm. There are no serious contra indications to pre-operative irradiation, the operation is not rendered more difficult nor is there any disturbance of the healing of the wound

ERNST A POHLE, M D Ph D

RADIOLOGY, PRACTICE OF

Radiology as an Aid to the General Practitioner
E Kaye Le Fleming *British Med Jour*, Sept 8, 1934 pp 462-464

Speaking as a general practitioner, the author believes that the closest contact and co-operation between the radiologist and the general practitioner is necessary. The science of radiology is technically outside the sphere of the knowledge of the general practitioner and is advancing so rapidly that the busy general practitioner cannot keep pace with it. Because of the expense of radiologic examination and irradiation therapy there is often some hesitancy in recommending an expensive form of examination or treatment without good knowledge of its nature and its probable efficacy. Therefore, there is a danger that the tie between radiologist and general practitioner may become weakened or even lost to the dis-

advantage of all concerned. The solution of this problem depends upon co operation among radiologists in the study of their results, and the systematic presentation of these results to the general practitioner who seeks them.

The author discusses the use of the x ray in the diagnosis and treatment of the most common conditions in which he seeks aid from the radiologist

J N ANL, M D

THE SPINE

The Oblique View for Demonstration of the Articular Facets in Lumbosacral Backache and Sciatic Pain
Ralph K. Ghormley and B R Kirklin *Am Jour Roentgenol and Rad Ther*, February, 1934, 31, 173-176

It is important that all patients complaining of back pain with sciatic radiation be studied carefully as to the small joints formed between the adjacent facets of the fifth lumbar and the first sacral vertebrae. This cannot be done well roentgenologically by anteroposterior and lateral examinations only, even when stereoscopy is employed, but by rotating the patient into an anteroposterior oblique position and using an angle of about 32 degrees from the horizontal, these joints can be clearly demonstrated and narrowing of joint space, marginal proliferation of bone, facet fractures, and anomalous development may be shown. It is the authors' belief that in cases in which there develops sudden sharp pain low in the back, with or without sciatic radiation, and in which relief is accomplished by manipulative procedures the seat of the trouble is more probably in these small articulations or their facets than in the ligaments alone.

J E HABBE, M D

THE STOMACH

The Cascade Stomach. Werner Kaufmann *Röntgenpraxis*, June 1934 6, 345-355

Cascade stomach has been explained by many different theories. According to the observation of the author this anomalous behavior of the stomach is usually caused by constitutional factors and is seen most frequently in stout persons, when the stomach is forced into a more or less horizontal position not much below the diaphragm. There are however, some other causes for it: extrinsic pressure on the stomach by an accumulation of fat in the region of the tail of the pancreas, or, in thin persons an accumulation of gas in the left colon. Gaseous distention of the stomach itself is of importance also, the air swallowed during eating expands the cardiac end of the stomach which tends to become as round as a balloon. Adhesions which pull the pyloric end of the stomach toward the right (cholecystitis, duodenal ulcer, etc.) may cause the same phenomenon. The cascade deformity of the stomach is constant in the constitutional type (stout persons with good abdominal muscles), it is not constant in cases in which a gas filled colon causes it. This colonic gas is usually not due to fermentation and indigestion, but rather, to hydrostatic pressure. Some

mitted to the hospital complaining of abdominal enlargement, swelling of the legs, jaundice, and a non-productive cough with slight dyspnea of short duration. She had had five miscarriages there were four living children. Chest examination showed dullness and crepitant râles at the right base and a soft systolic murmur at the apex. The spleen and liver were both enlarged. The blood Wassermann was four plus. X-ray examination showed a dense clouding in the right lower lung obliterating the diaphragm, which was attributed to atelectasis of the middle lobe. Also there was seen in the apex of the lower lobe an oval density measuring about 8 by 3 centimeters. Under antisyphilitic therapy the clouding partially cleared but the nodule remained unchanged. Shortly before death the patient developed râles in both lungs and a fever of 39.5° C. She died on the fiftieth day after admission. A clinical diagnosis of pulmonary syphilis had been made by ruling out tuberculosis and malignancy. At postmortem examination the gummatous mass in the inner upper portion of the right lower lung was found to be typical grossly and microscopically of syphilis. There were also scattered areas of fibrosis in the liver.

When syphilis attacks the lungs there may occur an interstitial fibrosis (commonest form), single or multiple gummatous masses, or diffuse lobar pneumonia (affecting infants chiefly). The gummatous lesions are more apt to respond to treatment than are the interstitial ones.

J E HABBE, M D

LYMPHATIC SYSTEM

A Roentgen Study of the Absorption by the Lymphatics of the Thorax and Diaphragm of Thorium Dioxide Injected Intrapleurally into Animals. L. J. Menville and J. N. Ané. *Am Jour Roentgenol and Rad Ther*, February, 1934 31, 166-172.

These workers were the first to visualize by roentgenologic methods the various portions of the lymphatic system by means of injection of thorium dioxide subcutaneously, intradermally and intrapleurally intraperitoneally intrapericardially and intracardially, both in laboratory animals and in selected human subjects. Laboratory animals included rats, dogs and rabbits. All cases examined were first radiographed then injected with the contrast medium and then studied both fluoroscopically and by serial roentgenograms at 24-hour intervals.

The first portion of the lymphatic system to be visualized following intrapleural injection was the sternal group of glands this occurring within an hour after injection hence the writers conclude that the first absorption was through the parietal pleura. Lymph vessels were visualized on both sides of the chest following injection into one side only thus clearly indicating the presence of connecting vessels between the two sides. The diaphragm of all laboratory animals absorbed thorium in greater quantities when the injections were intraperitoneal than when

intrapleural. Following intraperitoneal injection of thorium dioxide into a human being, visualization of both abdominal lymph vessels and glands and of thoracic glands was obtained.

J E HABBE, M D

THE OVARIES

Our Results in the Treatment of Carcinoma of the Ovary. C. Schroeder. *Strahlentherapie*, 1934, 51, 465.

Fifty-six cases (histologically proved) of carcinoma of the ovary were seen in the author's clinic from 1923 to 1929. A cure was obtained in 32.1 per cent. If arranged according to type of treatment it appeared that laparotomy plus irradiation cured 9 per cent, incomplete operation and irradiation 25 per cent, and radical operation plus irradiation 60 per cent. Patients who had laparotomy, complete operation, or no operation at all received 1800 r (in the depth) during a period of 14 days. Patients who had incomplete operation received a total of 900 r (in the depth) given in 11 days.

ERNST A. POHLE, M D, Ph D

PERITONEUM, TUBERCULOUS

Our Method of Roentgen Therapy of Tuberculosis of the Genital Organs and Peritoneum in Women. C. J. Gauss. *Strahlentherapie*, 1934, 51, 371.

The author reports his experience regarding roentgen therapy of tuberculous peritonitis in women. Of 40 cases treated in his clinic only 25 could be traced. Technic: K V (?), 1 mm Cu + 1 mm Al, 20 X 24 cm over anterior lower abdomen at 50 cm FSD. Every six weeks decreasing surface doses were given: 120, 100, 80, 60, and 40 r. Eighteen patients responded well to the treatment; four were improved and three only temporarily benefited. The menstruation was not disturbed in the majority, however no pregnancies occurred. The importance of an accurate diagnosis is emphasized, if necessary, laparotomy should be performed to establish the diagnosis.

ERNST A. POHLE, M D, Ph D

THE PROSTATE

Roentgen Treatment of Benign Hypertrophy of the Prostate Gland. Benjamin S. Barringer, Archie L. Dean, Jr., Ralph E. Herendeen and James J. Duffy. *Am Jour Roentgenol and Rad Ther*, March 1934 31, 350-355.

Thirty-four patients with benign prostatic hypertrophy have been given adequate trial deep x-ray therapy and followed for a sufficiently long time to permit the observers to determine their end results. Twenty-three of these 34 men had a residual urine of 60 cc or more; the others less than 60 cc. The former group would include those for whom prostatectomy would be advised by most urologists. Seven of these 23 cases showed improvement of symptoms with the residual urine being decreased to little or none. This percentage of successful results represents fairly well

infectious osteomyelitis, the onset is sudden, with no previous local symptoms. In this condition the temperature is high, with a marked increase in the total white cells and in polymorphonuclear neutrophils. In the early stage of Ewing's tumor the temperature is usually about from 99 to 100 degrees although it may be higher. While there may be a moderate increase in the total white cell count the differential count is usually about normal. The roentgenogram is of great value in the diagnosis for in acute pyogenic osteomyelitis the x ray examination is negative at the onset and remains negative for from two to four weeks. In Ewing's tumor however, there are always structural changes in the bone by the time the symptoms are apparent. The histologic examination of a section will reveal the presence of tumor in Ewing's, while the presence of organisms can be demonstrated by cultural methods in acute osteomyelitis. Differentiation of these conditions may be difficult, however, in a case of Ewing's tumor in which there has been an operation followed by a draining sinus. X ray therapy is likewise of value in the differentiation of these conditions for in Ewing's tumor a marked, rapid recession of the tumor will be noted while it will have no effect in a case of acute osteomyelitis.

The differentiation between osteogenic sarcoma and Ewing's tumor depends upon the history and the x ray examination. The rapidly growing osteolytic type of osteogenic sarcoma which results in destruction of the entire bone may appear similar to the third stage of Ewing's tumor after disintegration of the reactive bone layers of the periosteum has occurred. Irradiation therapy will prove of value in the differentiation, as osteogenic sarcoma does not respond to irradiation. Metastatic carcinoma may closely resemble Ewing's tumor as demonstrated by Hirsch and Ryerson in the case of a boy, six years old, with primary carcinoma in the bronchi.

J N ANÉ, M D

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(Film calculations 25 to 28 per cent increased over actual.) A difference of 1 mm or more in the width of the opening was encountered in 59 per cent of the normal cases. In 80 per cent of the proven tumor cases an expansion deformity of the canal is of more diagnostic importance than mere expansion of the orifice. Usually decalcification of the petrous bone accompanies the canal changes (58.8 per cent of these cases). Of the seven cases which showed no canal changes, five revealed areas of destruction in the petrous apex and dorsum sellae, thus localizing the tumor in the cerebello pontine angle. The other two cases gave signs of increased intracranial pressure only. Hence there were no cases with entirely negative x ray findings in the entire series of cases by this method of study.

J F HARBE, M D

TUMORS (THERAPY)

A Lymphosarcoma of the Stomach and its Cure by Roentgen Therapy. R. Kaiser. *Röntgenpraxis*, April, 1934 6, 233, 234.

An interesting case of lymphosarcoma of the stomach and an apparent eight year cure are described. In 1926 a large tumor of the stomach was diagnosed by roentgen examination. At operation an inoperable malignant tumor was found in the posterior wall, a biopsy proved the tumor to be a lymphosarcoma. Roentgen therapy was begun after operation, as the only possible chance for the patient. The tumor itself received about 70 per cent of an S E D from anterior and posterior fields. The treatment was repeated three times at intervals of three months. One year afterward there was no palpable tumor, the patient had gained 30 pounds and felt well. Another examination in 1934 revealed no pathology clinically nor roentgenologically.

H W HEFKE, M D

Irradiation Treatment of Malignant Intrathoracic Tumors. F G Chandler, N S Finzi, and James Maxwell. *British Med Jour*, Oct 20, 1934, pp 714-717.

The authors review a group of 70 cases of malignant intrathoracic tumors treated by irradiation therapy, and analyze the results obtained with this form of treatment. In the study of these cases microscopic examination of a section of the thoracic growth or of a metastasis was considered of greatest diagnostic importance. The material for examination was obtained by thoracotomy in seven cases, by bronchoscopy in seven, by removal of a metastasis in five, and from postmortem material in 19 cases. Careful and thorough clinical and roentgenologic examinations were obtained in all cases and no doubtful cases were included in this series.

Of the 70 cases of intrathoracic tumors, there were 44 of bronchial carcinoma treated by the x-ray with the following results. Twenty three cases showed marked relief of symptoms with an average duration of life after beginning treatment of 9.7 months, seven cases

of the symptoms of cascade stomach with excessive gas in the stomach and colon may be improved by reducing the amount of fat in the abdomen (diet), and by the patient taking abdominal and diaphragmatic exercises. In thin individuals with relaxed abdominal muscles gain in weight, exercise, and an abdominal support will achieve results.

H W HEFKE, M D

THE TESTES

The Function of the Testes after Puberty T E Hammond *British Jour Urol* June, 1934 6, 128-141

It has been held for years that without testes no spermatozoa could be formed and without spermatozoa no impregnation could take place, this still holds true. The functions attributed to the internal secretion is based on erroneous deductions.

The internal secretion is probably essential for the true development of the secondary sexual characters. When once these are formed removal of the glands leads to very little change though shaving need not be so frequently performed.

It has some action in stimulating sexual desire and power. After castration both persist but to a lessened degree and tend to disappear at an earlier age. The internal secretion probably has some action upon metabolism, as shown by the tendency to put on fat after castration. It may also have some action upon that elusive condition known as general tone. The secretion certainly has not that action upon the mental and physical well being which has in recent years been claimed for it.

DAVIS H PARDOLL, M D

THYROID (THERAPY)

Observations on Irradiated Cases of Thyrotoxicosis W Lahm *Strahlentherapie* 1934 51, 382

During 1932 and 1933, 110 cases of thyrotoxicosis received roentgen therapy in the author's clinic. Only patients with a basal metabolic rate above +20 are analyzed in this report. Technic 100-150 r over the thyroid and thymus once a week up to 700 r total dose. The spleen received 200 r if enlarged. The hypophysis was also treated occasionally by applying 150 r over a left and a right temporal field. Ovarian irradiation was sometimes given. The results were very gratifying as indicators for improvement the author uses the weight and the subjective symptoms particularly heart symptoms and also the basal metabolic rate. In men the disease seems to take a more severe course and is more difficult to influence than in women.

ERNST A POHLE M D Ph D

TONSILS

Ten Years Experience with Roentgen Therapy in Non-malignant Disease of the Tonsils in Over One Thousand Patients G Schulte. *Strahlentherapie*, 1934, 51, 365

During the period 1924-1934 the author treated over a thousand cases of chronic tonsillitis with roentgen rays. Technic 180 KV 1 Cu + 1 Al, 6 X 8 cm

field, 30 cm FSD 175 r over left and right cervical area central ray directed to angle of jaw. If the treatment was tolerated well two fields were applied on one day. Treatment was repeated after four and if necessary, after eight weeks. In children 140 KV, filtered through 4 Al and a total of 135 r usually suffices. The results were excellent 86.1 per cent were cured 11.9 per cent improved, and 2 per cent did not derive any benefit from the treatment. Seven of the latter cases were operated on. The author believes that if cases are carefully selected, even better results may be expected. The advantages of irradiation as compared with operation are briefly discussed.

ERNST A POHLE, M D, Ph.D

TUMORS (DIAGNOSIS)

Endothelial Myeloma An Analysis of Cases Willis C Campbell *Jour Bone and Joint Surg.*, October, 1934, 16, 761-780

The author analyzes 23 cases which presented factors more or less suggestive of endothelial myeloma. Of these, 11 cases were classified by the Registry of Bone Sarcoma of the American College of Surgeons as endothelial myeloma, and three cases as unclassified sarcoma. Six cases of endothelial myeloma were not submitted to the Registry of Bone Sarcoma, and in three the final diagnosis of the bone pathology was inflammation.

Roentgenographic examination of the 17 cases of endothelial myeloma showed that there were 11 tumors in the shaft of the long bones, two near the ends of the long bones, one on the end of the bone, one in the ilium, one in a rib, and one in the pubic bone. Four of the 17 patients had had operations for acute osteomyelitis. Four cases gave a history of sudden onset and in only one of these was the patient treated for osteomyelitis.

Five of the 11 registered cases had x-ray treatment and Coley's toxins and of these three are living and well, 7, 4 and 3 years respectively after treatment. However, two of these three patients also had amputation in addition to x-ray therapy and toxins. X-ray treatment was employed in two cases with improvement in both. This was more marked in the patient who lived four and one half years after treatment.

The symptoms of intermittent pain, with swelling found in Ewing's tumor is also seen as a result of syphilis osteomyelitis of Garré subacute and low grade osteomyelitis and osteogenic sarcoma. In syphilis the Wassermann reaction and the roentgenographic demonstration of the bone changes will help in the differentiation. In Garré osteomyelitis there is often a history of a sudden onset with a slight elevation of temperature but no recurrent attacks. The bone changes of Garré osteomyelitis consist of condensation and spindle shape enlargement with proliferation of the periosteum. In the early stage of Ewing's tumor there is condensation but no expansion. In the second stage there is proliferation of the periosteum, with destructive changes in the shaft.

The differentiation of acute infectious osteomyelitis and Ewing's tumor is of great importance. In acute

infectious osteomyelitis, the onset is sudden, with no previous local symptoms. In this condition the temperature is high with a marked increase in the total white cells and in polymorphonuclear neutrophils. In the early stage of Ewing's tumor the temperature is usually about from 99 to 100 degrees, although it may be higher. While there may be a moderate increase in the total white cell count the differential count is usually about normal. The roentgenogram is of great value in the diagnosis for in acute pyogenic osteomyelitis the x ray examination is negative at the onset and remains negative for from two to four weeks. In Ewing's tumor, however, there are always structural changes in the bone by the time the symptoms are apparent. The histologic examination of a section will reveal the presence of tumor in Ewing's while the presence of organisms can be demonstrated by cultural methods in acute osteomyelitis. Differentiation of these conditions may be difficult; however, in a case of Ewing's tumor in which there has been an operation followed by a draining sinus. X ray therapy is likewise of value in the differentiation of these conditions for in Ewing's tumor a marked rapid recession of the tumor will be noted while it will have no effect in a case of acute osteomyelitis.

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showed incomplete but definite relief of symptoms, with an average duration of life of 8.6 months. Fourteen cases showed no change in condition of the patient after treatment and had an average duration of life of 5.4 months. In ten cases of bronchial carcinoma in which radium or radon was introduced directly into the growth through a bronchoscope the average duration of life after the operation was 2.4 months. In two cases radium was inserted into the tumor through the chest wall. One case showed marked temporary diminution of the tumor and in the other patient a decided improvement was noted for a few months.

The nine cases of malignant tumors other than bronchial carcinoma included the following: Secondary hypernephroma, primary sarcoma, secondary sarcoma, secondary carcinoma, and endothelioma from the thymus. In four cases of this series treatment had little or no effect, in two cases hemoptysis was apparently controlled, and in one case the intrathoracic growth was seen to diminish in size. The two remaining cases, which were diagnosed as endothelioma from the thymus and secondary carcinoma from the thyroid, are alive 11 and 21 years, respectively, after treatment.

The remaining five cases presented in detail by the authors include those in which both the clinical picture and the x-ray appearance suggested malignant tumor but in which no histologic proof of the nature of the mass was obtained. In all of the cases of this group either cure or great relief has occurred.

J. N. ANÉ, M. D.

THE UTERUS

Radiation Therapy of Uterine Carcinoma. F. Voltz. *Strahlentherapie* 1934, 51, 453.

The author analyzes further the results obtained at the Women's Clinic, University of Munich, in radiation therapy of uterine carcinoma. From 1913 to 1928, 2,202 patients were admitted, 2,039 were treated, and 395 were cured (17.9 per cent). The respective result in early cases (Group I) was 45.1 per cent. A comparison with the cases treated in 1927 or 1928, with more

efficient technic, shows that the total percentage of cure amounted to 22.6 per cent. In carcinoma of the fundus the percentage of cure amounted to 40.6 per cent in cases seen during the period from 1913 to 1928.

ERNST A. POHLE, M. D., Ph. D.

Intravaginal Irradiation at Close Range of Carcinoma of the Cervix. H. Martius. *Strahlentherapie* 1934, 51, 477.

It is a recognized fact that carcinoma of the cervix can be treated adequately by locally applied radium but that the peritoneum does not receive a sufficient amount of radiation. The author recommends for this purpose the new 'body cavity x-ray tube' developed by Schaefer and Witte. With proper technic it is possible to get as much as 4,000 r to the pelvic wall without producing injury. There is very little systemic reaction, an observation which may be explained by the fact that only a small volume of tissue is irradiated.

ERNST A. POHLE, M. D., Ph. D.

The Development of Radiation Therapy of Uterine Carcinoma. A. Lacassagne. *Strahlentherapie*, 1934, 51, 417.

The author gives a brief history of the development of the technic in radiation therapy of uterine carcinoma. The method practised in the leading clinics in the entire civilized world are briefly discussed. A very complete bibliography is appended to the article.

ERNST A. POHLE, M. D., Ph. D.

Supplementary Radium Treatment in Roentgen Therapy of Uterine Carcinoma. H. Wintz. *Strahlentherapie* 1934, 51, 441.

For the last twenty years the author has treated with roentgen rays alone most of the cases of uterine cancer seen in his clinic. He compares his statistics with those of other clinics using a combined roentgen and radium therapy, and concludes that only patients treated with insufficient quantities of roentgen rays should have intra-cervical or intra-uterine radium application.

ERNST A. POHLE, M. D., Ph. D.

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THE TREATMENT OF CARCINOMA OF THE PHARYNX AND LARYNX¹

By L H GARLAND, M B , B Ch , *San Francisco*

From the Stanford University Service at the San Francisco Hospital, Department of Public Health and Stanford University Medical School

THIS paper is a summary of the technic and early results of the treatment of cancer of the pharynx and larynx by protracted fractional roentgen radiation in a rather small group of cases. Its value, if

clinics and anti-cancer centers where facilities, both pathologic and radiologic, far exceed those in the average community. Since it is not always possible for patients to gain access to those centers, the results

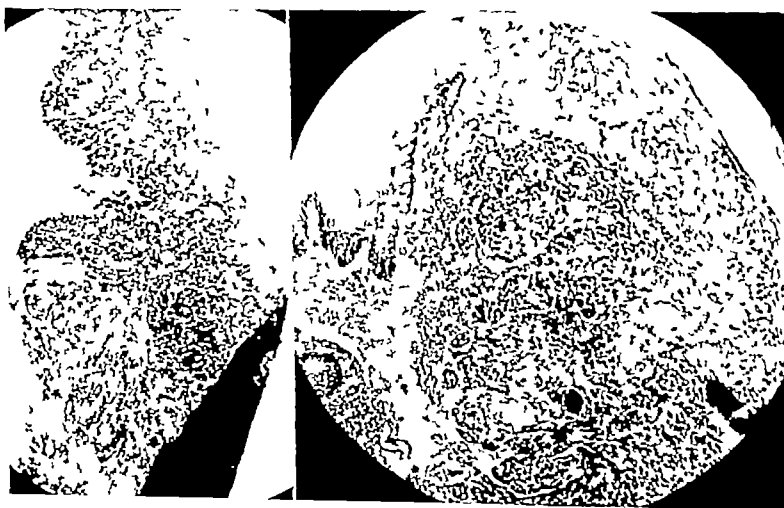


Fig 1

Fig 2

Fig 1 Case 1 Moderately well differentiated carcinoma of the larynx. Section near edge of tumor showing cells invading the submucosa (epidermoid carcinoma).

Fig 2 Case 8 Well-differentiated carcinoma of the larynx. Section near edge of lesion. Slight keratinization (squamous-cell carcinoma).

any, will lie in its being a record of the results obtainable under average conditions in an ordinary city hospital of average size. Most of the literature on this subject to date consists of summaries from the larger

obtainable outside of them may, therefore, be of interest.

Types of Lesion Treated Classification — Most of the cases treated were either advanced or inoperable, several of the laryngeal cases were recurrent post-operative ones. None of them were regarded by the referring surgeon, rhinolaryngologist, or

¹ Read before the Radiological Society of North America, at the Twentieth Annual Meeting, in Memphis Tenn, Dec 3-7, 1934

TABLE I — CLASSIFICATION OF TUMORS OF THE LARYNX AND PHARYNX

LARYNX		
Type of Cell	Well differentiated carcinoma	A squamous-cell epithelioma (epidermoid carcinoma) composed chiefly of differentiated cells showing keratinization and pearl formation. Often arises from the true vocal cords, the glosso-epiglottic recess and the lateral pharyngeal wall. "Radiosensitive" but requiring large doses to cure. Usually metastasizes to glands late. Commonly graded 1 and 2.
	Poorly differentiated carcinoma	A squamous-cell epithelioma (epidermoid carcinoma) composed chiefly of anaplastic cells of the squamous variety showing no keratinization and little if any orderly arrangement. Often arises from the superior or false cords, the aryepiglottic area, the pyriform sinus or the posterior pharyngeal wall. "Radiosensitive" Sometimes metastasizes to glands early. Commonly graded 3 and 4.
	Sarcoma	Including lymphosarcoma, rare
Size	Stage I	Small localized tumor not over 1 cm in extent, usually intrinsic and often confined to one vocal cord.
	Stage II	Medium sized, localized tumor not over 4 cm in extent, often largely, if not entirely, intrinsic.
	Stage III	Large tumor, over 4 cm in extent, often both intrinsic and extrinsic. All tumors with cervical adenopathy.

PHARYNX

Type of Cell	Well differentiated carcinoma	See above. Often arises from the posterior faucial pillars, the velum and the lateral pharyngeal wall. Sensitivity and grading as above.
	Poorly differentiated carcinoma	See above. This group includes transitional cell carcinomas or lympho-epitheliomas, the latter being squamous-cell tumors which arise in contact with lymphoid tissue. "Radiosensitive." Metastasize fairly early.
	Sarcoma	Includes lymphosarcoma, so-called reticulum cell sarcoma, and other specific types. The 'radiosensitivity' being in the order mentioned. Commonly arise from the oropharynx (tonsil, base of tongue, etc.).
Size	Stage I	Small tumor up to 2 cm in diameter.
	Stage II	Medium sized tumor from 2 to 5 cm in diameter.
	Stage III	Large tumor over 5 cm in diameter. Tumors with definite adenopathy.
Region	Epipharynx	Posterior nasopharynx, adenoid and upper soft palate area, etc.
	Mesopharynx	Tonsil and tonsillar folds, posterior oropharynx and base of the tongue, etc.
	Hypopharynx	Pyriform sinuses, base of epiglottis, post-cricoid area, etc.

physician as suitable for operation There were 10 cases of cancer of the larynx and 14 of cancer of the pharynx

its histologic appearance and that, therefore, this appearance should not be used as an index for or against radiation therapy



Fig 3 Case 15 Moderately well differentiated carcinoma of the anterior tonsillar pillar Extensive invasion (epidermoid carcinoma)

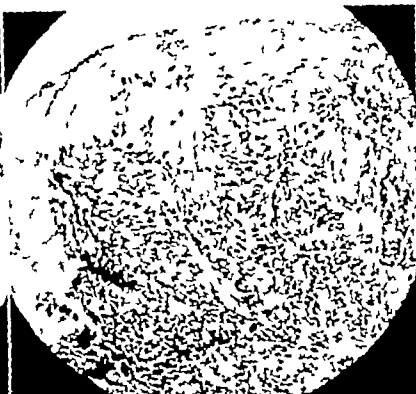


Fig 4 Case 22 Moderately well differentiated carcinoma of the tonsil Extensive invasion of the submucosa (epidermoid carcinoma)

We have attempted to classify cases on three different points (1) the histologic appearance, (2) the clinical size of the tumor, and (3) the region involved (see Table I)

Histologic grading after Broders' method has not been done by our Department of Pathology, however, most of the cases have been divided into well-differentiated or poorly differentiated ones Since Coutard (1) believes that some poorly differentiated carcinomas may be cured by a short, intense course of roentgen therapy, while well-differentiated ones nearly always require a long, low intensity, high total dosage course, the histologic grading would appear, at first glance, to be an important guide to therapy Unfortunately, however, in the individual case one cannot rely on the histologic prediction for purposes of estimating the dose, one has to be guided by the actual response of the tumor during treatment Not only do some poorly differentiated epitheliomas respond slowly and require massive dosage for their arrest, but some sarcomas of the tonsil (spindle-cell reticulomas) are said to be very radioresistant (2) Cutler (3) and others (4) are of the opinion that it is no longer possible to estimate the radiosensitivity of a tumor by

Radiosensitivity does not always imply curability (*cf* Hodgkin's disease) nor does radio-resistance indicate incurability (*cf* small papillary adenocarcinomas) According to Broders *et al* (5) the most common tumors of the pharynx and base of the tongue are the lymphosarcomas and the poorly differentiated epitheliomas the most common tumors of the larynx are the well or fairly well-differentiated epitheliomas

The clinical size of the tumor is quite important, since much larger doses of x-rays can be given with safety to small areas than to large ones Coutard has observed that in his clinic very small lesions had been cured in 15 days, lesions of medium size in about 22 days, and large lesions with adenopathy in about 38 days We realize that a tumor may be much more extensive microscopically than it appears to be clinically, but we believe that one must take the risk of treating too small a field in order safely to deliver an adequately large dose, it seems probable that, if the lesion is much more extensive than the average field used in this work, it would have been incurable anyway

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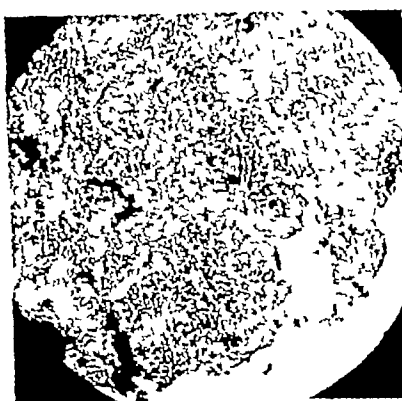


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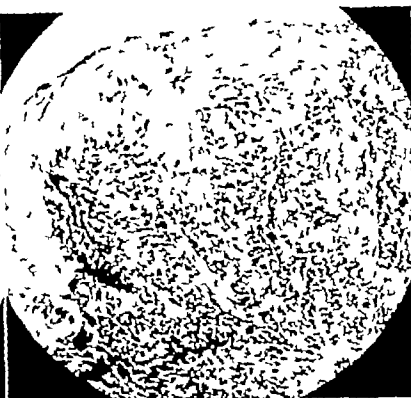


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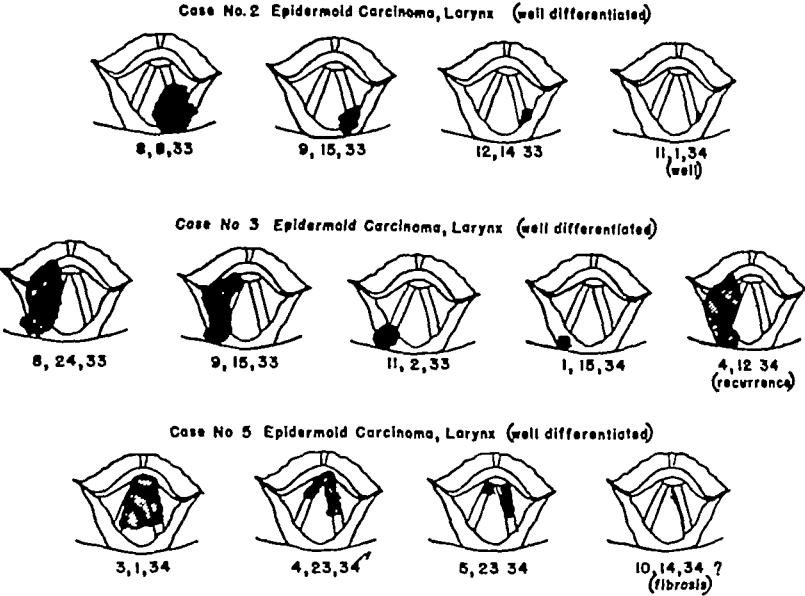
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4 The presence of much secondary infection or of invasion of cartilage or bone is said to render cure unlikely However,

DIAGRAMS, SHOWING BEHAVIOUR OF LARYNGEAL LESIONS UNDER ROENTGEN THERAPY



These are tracings from sketches made by the Laryngologist at time of examination

Fig 5 Diagram showing response of laryngeal lesions to roentgen therapy

- 1 The type of the tumor All poorly differentiated ones and some well-differentiated ones offer reasonable chances of cure
- 2 The extent of the tumor Very extensive lesions usually cannot be given adequate dosage and, therefore, only palliation should be anticipated
- 3 The region of the tumor High pharyngeal tumors are less apt to receive adequate dosage than low or laryngeal ones

- small doses, intended only to be palliative, may both save the patient from an obstructive emergency and prolong life considerably
- 5 The general condition of the patient is obviously of importance, aged or debilitated persons will not usually tolerate prolonged vigorous roentgen treatment This factor alone may prevent treatment being given to an otherwise suitable case

TABLE II —CLASSIFICATION OF CASES TREATED ACCORDING TO EXTENT OF LESION (ROUGHLY, INTO EARLY, MODERATE, AND ADVANCED CASES)

				Stage I	Stage II	Stage III
Pharynx	Mesopharynx	Soft palate etc		0	0	1
		Posterior oral area		0	0	3
		Tonsil and tonsillar pillars		0	1	5
		Base of tongue		0	0	3
	Hypopharynx			0	0	1
Larynx				0	6	4
Total				0	7	17



Fig 6 Case 3 Well differentiated carcinoma right vocal cord, involving base of epiglottis and both arytenoids Very extensive encroachment on upper laryngeal air space, emergency tracheotomy

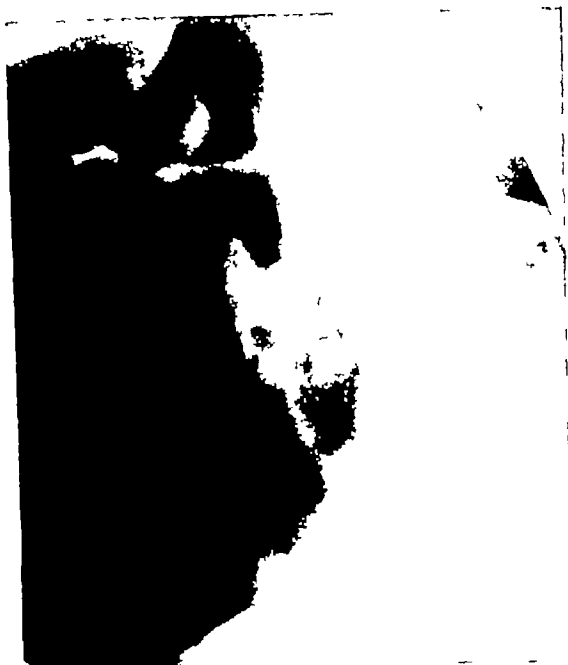


Fig 7 Case 3 Same case as in Figure 6, after treatment Air shadow of vestibule almost normal, slight residual edema of arytenoid areas Voice was normal

Technic—Preliminary films of the larynx and chest are made in each case and a biopsy is secured before or within the first week of commencing treatment. The patient is examined in conjunction with the referring surgeon or laryngologist and the position and estimated extent of the lesion are marked on each side of the surface of the neck. For localized laryngeal cases a field at least 3 cm wider on each margin than the estimated maximum size of the tumor is used. For pharyngeal cases it is customary to use fairly large fields, as large as 14×14 cm, at least at the beginning of the course. The daily dose varies from 100 to 300 r, depending on the size of the field treated, the amount of obstruction to respiration present, and the general condition of the patient. Such a dose is given daily to alternate sides of the neck over a period of from 4 to 8 weeks.

The factors used are 200 K V P, 30 ma, Thoraeus filter (0.4 mm Sn 0.25 mm Cu, 1.0 mm Al), effective wave length 0.125

Å, half value layer 1.5 mm Cu, 50–60 cm target-skin distance. The exact size and shape of the field varies in every case, and from time to time in the same case. A long, cylindrical cone is used to center accurately the beam over each field. Pieces of "radio-paque" lead rubber (2 mm thick, absorbing 95 per cent of the primary beam) are often used to outline the exact area under treatment. The patient usually lies on his back with one shoulder moderately elevated, the projection of the beam being an oblique rather than a true lateral one.

During the fourth or fifth week, in fairly rapidly given courses, the usual "radio-epidermitis" develops, necessitating soothing skin applications, such as pieces of gauze soaked in mineral oil or smeared with boric acid ointment. At the end of the fourth week "radio-epithelitis" is usually present, necessitating sedatives and a liquid diet. Every effort is made to see that the patient takes plenty of fluids, sleeps well, and does not catch cold. Some of the

sidering the desirability of submitting a patient to curative doses of roentgen radiation

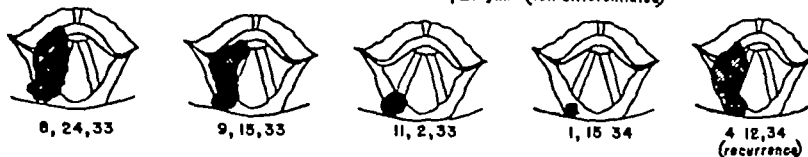
4 The presence of much secondary infection or of invasion of cartilage or bone is said to render cure unlikely. However,

DIAGRAMS, SHOWING BEHAVIOUR OF LARYNGEAL LESIONS UNDER ROENTGEN THERAPY

Case No. 2 Epidermoid Carcinoma, Larynx (well differentiated)



Case No. 3 Epidermoid Carcinoma, Larynx (well differentiated)



Case No. 5 Epidermoid Carcinoma, Larynx (well differentiated)



These are tracings from sketches made by the Laryngologist at time of examination.

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		Tonsil and tonsillar pillars	0	1	5
		Base of tongue	0	0	3
	Hypopharynx		0	0	1
Larynx			0	6	4
Total			0	7	17

TABLE III —CARCINOMAS OF THE LARYNX AND PHARYNX TREATED BY ROENTGEN THERAPY
(MODIFIED COUTARD)

Case No	Age, sex	Site, type and stage of lesion	Date treatment begun Length of tr in days	Dosage (r in air) and size of fields	Results
1	56 M	Epidermoid ca, well-diff right side of larynx, involving pyriform sinus Stage II	10-4-33 40 days	2,400 r left 2,600 r right, fields av 7.5 cm diam (T D 8,000 r/skin)*	Clinically well to date (13 months)
2	56 M	Epidermoid ca mod well diff left vocal cord Stage II tracheotomy 8-4-33	8-10-33 50 days	4 400 r anterior, 1 000 r left, 800 r right, fields 7 X 6 cm ant, 9 cm diam lateral (T D 7,750 r/skin)	Clinically well to date (15 months)
3	60 M	Epidermoid ca well-diff, right vocal cord Stage II tracheotomy 8-17-33	8-24-33 35 days	3,600 r right 2 200 r left, fields av 9 X 5 cm (T D 7,250 r/skin)	Clinically well 7 mos Recurred Second course given—32 days 2,400 right, 2,500 left, fields 9-10 cm diam (T D 6,100 r/skin) Improved
4	65 M	Epidermoid ca well-diff, left side of larynx involving pyriform sinus Stage II	10-4-33 40 days	2,400 r right, 2,400 r left fields 10 X 8 cm (T D 6 000 r/skin)	Tracheotomy 10-13-33, bronchopneumonia 11-20-33 Died 11-29-33 Postmortem showed marked roent changes in residual tumor tissue Cause of death mult pulmonary abscesses, mediastinitis
5	57 M	Epidermoid ca, both cords recurrent post-operative (2 months) Tracheotomy Stage II	3-2-34 43 days	3,300 r left, 3 600 r right, fields 8 X 6 cm (T D 8 600 r/skin)	Clinically arrested 8-1-34, developed mod fibrosis about larynx, pneumonia 10-14-34 and death No post-mortem allowed Arrested (?)
6	71 M	Carcinoma (unclass) left retrolaryngeal area with cervical adenopathy Stage III	11-15-33 26 days	3,100 r left, 3,100 r right fields 9 cm diam (T D 7,750 r/skin)	Developed left hemiparesis 12-29-33 voice improved, but dev metastases in spine and ribs Died 1-14-34, no post-mortem allowed
7	59 M	Carcinoma (unclass), larynx advanced, recurrent post-operative (2 years) Tracheotomy, Stage III	9-26-33 32 days	2 400 r left, 2,400 r right, fields 10 X 8 cm (T D 6 000 r/skin)	Developed remarkable improvement with ability to speak, bronchopneumonia dev foll removal tracheot tube. Death 1-21-34, no post-mortem allowed
8	58 M	Epidermoid ca well-diff, right arytenoid area Stage II	8-3-34 34 days	2,700 r right 2,700 r left, fields 14 X 10 cm for first half of course then 9 cm diam (T D 6,750 r/skin)	Marked improvement, voice excellent to date (one month) Patient also had stenosing lesion mid third esoph for which gastrostomy was done 9-20-34

laryngeal cases, having a relatively new tracheotomy opening, are apt to develop a mild tracheobronchitis with a catarrhal discharge

through an indwelling esophageal (post nasal) catheter in only one case. We have had no tracheotomies except those that preceded treatment.



Fig 8 Case 7 Very extensive carcinoma of larynx recurrent post-operative. Tumor extends from base of tongue down to 2 cm. below the vocal cords. Note that the vertical extent of the tumor can best be shown by roentgen examination. This tumor shrank over 50 per cent following roentgen therapy showing the surprisingly good palliation achievable in some advanced cases.

Depending upon the response of the tumor to treatment, the dosage may be continued. As other authors (6) have noted, the radio-epidermitis and epithelitis may commence healing and continue to heal even though treatment is continued.

The medical care of the patient is of considerable importance. We have attempted to follow Quick's (7) suggestions, especially those concerning oral hygiene, and have been gratified by the results when patients co-operated or had facilities for the frequent washings and irrigations involved in Quick's régime. We have fed the patient

In future with oropharyngeal cases we intend to suspend beside the bedside of the patient an irrigator containing potassium permanganate 1-4,000 with which the patient will irrigate his mouth four times a day (a quart to each irrigation). This would be most used during the third to fifth weeks.

Results—The actual results in our series of cases are tabulated in Table IV. All of the 24 cases, except one, were controlled by biopsy, 22 were epitheliomas and one was questionable. This latter case and the one in which biopsy was not done were both

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3	60 M	Epidermoid ca, well-diff, right vocal cord Stage II tracheotomy 8-17-33	8-24-33 35 days	3,600 r right, 2,200 r left, fields av 9 X 5 cm (T D 7,250 r/skin)	Clinically well 7 mos Recurred Second course given—32 days: 2,400 right, 2,500 left fields 9-10 cm diam (T D 6,100 r/skin) Improved
4	65 M	Epidermoid ca, well-diff, left side of larynx, involving pyriform sinus Stage II	10-4-33 40 days	2,400 r right 2,400 r left fields 10 X 8 cm (T D 6,000 r/skin)	Tracheotomy 10-13-33 bronchopneumonia 11-20-33 Died 11-29-33 Postmortem showed marked roent changes in residual tumor tissue Cause of death mult pulmonary abscesses mediastinitis
5	57 M	Epidermoid ca, both cords recurrent post-operative (2 months) Tracheotomy Stage II	3-2-34 43 days	3,300 r left 3,600 r right, fields 8 X 6 cm (T D 8,600 r/skin)	Clinically arrested 8-1-34, developed mod fibrosis about larynx pneumonia 10-14-34 and death No post-mortem allowed Arrested (?)
6	71 M	Carcinoma (unclass), left retrolaryngeal area, with cervical adenopathy Stage III	11-15-33 26 days	3,100 r left 3,100 r right, fields 9 cm diam (T D 7,750 r/skin)	Developed left hemiparesis 12-29-33 voice improved, but dev metastases in spine and ribs Died 1-14-34, no post-mortem allowed
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TABLE III (Continued)

Case No	Age, sex	Site, type, and stage of lesion	Date treatment begun Length of tr in days	Dosage (r in air) and size of fields	Results
9	63 M	Epidermoid ca, larynx Massive tumor re current post-operative (3 operations) 2 years Stage III	3-28-34 27 days	3 200 r right, 3,000 r left fields av 10 cm diam (T D 7,750 r/skin)	Tumor shrank and disappeared Clinically well 11-1-34 (8 months)
10	53 M	Epidermoid ca, poorly diff larynx with massive right cervical adenopathy Stage III	9-29-34 35 days	3,000 r left, 3 000 r right fields 14 X 14 cm, then 14 X 12 cm, then 9 cm diam (T D 7 500 r/skin)	Tumor shrank, adenopathy diminished
11	77 M	Tumor post - pharyngeal wall clinically definite carcinoma (Dr Bacher and Dr Graham) no biopsy Dysphagia and hoarseness 5 months Stage III	6-21-34 80 days	3,100 r left 3 300 r right fields 9 cm diam (T D 8 000 r/skin)	Treatment elongated by two-week interruption in June (bronchopneumonia) Tumor gone 11-1-34 (two and one-half months)
12	59 M	Carcinoma base of tongue, poorly diff, bilat cerv adenop Stage III	12-28-33 36 days	3 000 r left 3 000 r right fields 14 X 10 cm except last six dose fields 7 cm diam (T D 7 500 r/skin)	Tumor disappeared, but pt developed stenosing ca mid-esoph This received 1,700 r/o to each of four oblique 20 cm diam fields at 70 cm T S D in 34 days Temp improvement. Died 6-18-34 Postmortem showed bronchopneumonia, ca tongue arrested ca esoph (6 months)
13	65 M	Ca base of tongue unclass squamous cell rt upper cerv adenop Stage III	9-19-33 33 days	2 720 r right 2 750 r left, fields 11 cm diam later 9 cm diam (T D 6,830 r/skin)	Tumor shrank but did not disappear Developed sudden throat hemorrhage 11-26-33 and died in ten minutes—(?) from shock or some vascular accident No postmortem
14	72 M	Ca right tonsil large fungating (type unclass) with cerv adenop rt Stage III	1-13-33 54 days	3 600 r right 2 700 r left, fields 10 cm diam (T D 7 800 r/skin)	Lesion, including the adenopathy disappeared Recurrence 4-18-34 (15 months) Further treatment refused Alive 22 months
15	46 M	Ca ant pillar left tonsil with cervical induration Squamous cell well diff Stage II	8-14-34 36 days	3 000 r left 3 000 r right, fields 9 cm diam (T D 7 500 r/skin)	Clinically well, 11-1-34 (one month)
16	56 M	Ca base of tongue rt upper cerv adenopathy Unclassified Stage III	1-12-33 50 days	4 000 r right 2 800 r left fields 10 cm sq (T D 8 400 r/skin)	Tumor and adenopathy shrank leaving only tiny nodule on tongue. Pt developed severe left craniofacial pain Intracranial section left 9th nerve done 6-19-33 with immediate post-operative death Arrested 4 months No post mortem

TABLE III (Continued)

Case No	Age, sex	Site type, and stage of lesion	Date treatment begun Length of tr in days	Dosage (r in air) and size of fields	Results
17	48 M	Ca left side tongue, junct mid and post third large ulcerating with left sub max adenop Un-classified Stage III	6-1-33 41 days	3,000 r left, 2,100 r right fields 18 cm diam (but protecting part of parotid and laryngeal area) (T D 6,400 r/skin)	Tumor and adenopathy receded but did not disappear Hemorrhage from lingual artery 9-10-33 with death Postmortem showed ca confined to tongue, broncho pneu Improved 2 months
18	60 M	Ca soft palate and post wall of pharynx, epidermoid type Diffuse involvement uvula and both post faucial pillars Stage III	9-13-33 22 days	2 000 r left 2,000 r right fields 10 X 8 cm (T D 5 000 r/skin)	Clinically arrested to date (12 months) General health poor owing to morphine addiction Complains of left hemicrania (met to middle fossa ?)
19	70 M	Epidermoid ca left tonsil, with left cerv adenopathy Stage III	5-6-33 33 days	2,800 r right, 2 700 r left fields 10 X 10 cm (T D 6 900 r/skin)	Lesion shrank but small nodule persisted on post pillar Given 3 650 r/o to 7 cm area at left angle jaw in Sept (22 days) but lesion did not completely disappear Died 4-20-34 No postmortem
20	62 M	Ulcerating tumor post third left cheek at angle of jaw clinically ca but biopsy unsatisfactory (specimen inadequate) Stage II	9-15-33 17 days	3,000 r left field 9 X 6 cm (T D 3,700 r/skin)	After 2 months lesion not entirely gone given 1 200 r/o un filtered to lesion directly (through lead tube) and 1,200 r/o externally in 12 days Dec, 1933 Lesion clinically well 2 mos Prostatic resection bronchopneumonia and death 3-12-34 No postmortem
21	78 F	Angio epithelioma left tonsil very large tumor Stage II	9-14-33 18 days	3 000 r left, field 9 cm diam (T D 3 800 r/skin)	This patient had received moderate courses of radiation in Dec, 1932 and June, 1933 This fact and her age prevented more vigorous treatment Lesion much improved but not arrested Alive to date in relatively good condition (12 months)
22	58 M	Epidermoid ca right tonsil with cervical adenopathy Stage III	1-23-33 12 days	2 160 r left, 2 160 r right, fields 10 X 10 cm (T D 5 400 r/skin)	Tumor shrank Radical neck dissection 3-18-33 (few ca areas in sections) Developed pneumonia and died on 11-10-33 Post-mortem showed no ca in the tonsil or tongue area, but low in the cervical scar one tiny nodule was found Arrested 9 months

TABLE III (Continued)

Case No	Age, sex	Site type and stage of lesion	Date treatment begun Length of tr in days	Dosage (r in air) and size of fields	Results
23	73 M	Ca right tonsil, involving rt half base of tongue with rt submaxillary adenopathy Stage III	8-3-33 58 days	3 300 r left 3 500 r right fields 18 cm diam for half of course then 9-10 cm diam (T D 8 500 r/skin)	Tumor shrank but did not entirely go away Pt dev pneumonia and died 1-14-34 (4 months) Postmortem showed very little tumor tissue in the tonsil (looked "non viable"), glands neg
24	66 M	Epidermoid ca post portion of floor of mouth, fairly well diff Submax. adenop Stage III	11-24-33 35 days	3 100 r right 3 000 r left fields 14 X 10 cm for three - fourths of course 9 cm diam for remainder (T D 7,600 r/skin)	Tumor shrank and was cauterized 12-29-33, eight gold radon seeds inserted 3-15-34, bleeding required ligation left ext carotid 6-8-34 Dev bronchopneumonia and died 6-15-34. Postmortem showed tumor not arrested

* T D is the total dose to all fields, including back-scatter (estimated at approximately 25 per cent for the average 10 cm diameter neck field) It is given purely for ready comparison of our doses with those mentioned in the French and other literatures

clinically definite carcinomas While clinically cured, death from post-prostatectomy complications removed the "questionable case" from the group of arrested ones now living The patient without biopsy is alive and well (only three months have elapsed since the end of treatment)

There were 14 cases of carcinoma of the pharynx, seven were not arrested by treatment and seven were clinically arrested at the end of their course One of these recurred (after 15 months), and three died of intercurrent disease, leaving but three cases clinically well at the time of making this report The three cases that died of intercurrent disease are as follows

Patient with cancer of base of tongue (No 12) who died six months after the end of treatment from an independent cancer of the mid-esophagus and bronchopneumonia Palpation and inspection (removal not permitted) of the tongue showed no tumor

Patient with cancer of the posterior oral area (No 20) who died two months after the end of treatment, from pneumonia complicating prostatic resection No post-

mortem was allowed A clinically arrested case

Patient with cancer of the tonsillar area (Fig 4) involving the base of the tongue (No 22) who died nine months after the end of treatment from pneumonia complicating a simple cold At autopsy, careful examination of the tonsillar area and tongue revealed no evidence at all of carcinoma, but at the base of a long left cervical scar (the patient had a bloc dissection following roentgen therapy) a tiny microscopic nodule of carcinoma was discovered after prolonged search

There were 10 cases of carcinoma of the larynx, five were not arrested by treatment, and five were clinically arrested It is only fair to point out here that three of the five not arrested were very advanced, indeed hopeless cases One of the arrested cases recurred, seven months following treatment (Fig 5)

Complications—There was no mortality directly attributable to the roentgen treatment in this series of patients No late necroses of cartilage or bone, nor pharyn-

geal obstructions developed. One patient (No 5) developed some fibrosis about his tracheotomy opening about two months following treatment. He had had an extensive cancer of the larynx, recurrent two months after operation by a skilled laryngologist, and also much secondary infection about the tissues of his neck. His tumor disappeared following treatment, but thick fibrous tissue about the mid-laryngeal area

prevented removal of the tracheotomy tube. He developed pneumonia four months following treatment and died, no autopsy could be obtained.

Two of the pharyngeal cases developed severe hemorrhages from the tumor area one, one month following treatment, the other, four months following treatment. However, during the same period, two other cases that received little or no radia-

TABLE IV —ROENTGEN THERAPY RESULTS

Lesion	Cases treated	Improved but not arrested	Arrested but recurred	Clinically well	Arrested but died of intercurrent disease	Dead with or of cancer
Mesopharynx	13	7	1	2	3*	6
Hypopharynx	1			1		
Larynx	10	5	1	4		4

Total cases treated	24
Clinically arrested at end of tr	12 (50%)
Recurrence to date	2 (16%) one at 7, one at 15 months
Clinically well to date	7 (29%)
Well over 8 and up to 18 months	4 (16%)

* See text

TABLE V —COMPARISON OF THE RESULTS OF TREATMENT OF CANCER OF THE PHARYNX AND LARYNX*

1 Roentgen Therapy

Author	Lesion	No cases	Results	
			Primary healing	Later results
Coutard	Ca tonsil	46		12 or 26% (4 years and over)
	Hypopharynx	89		12 or 13% (4 years and over)
	Larynx	77		22 or 28% (4 years and over)
Schnitz	Pharynx and larynx	116	65 or 56%	40 or 34% (9 mos -3 yrs)
Maisin	Pharynx	74	25 or 34%	19 or 26% (2 years and over)
Lenz	Pharynx and larynx	31		14 or 45% (9 mos -2 yrs)

2 Surgery

Patterson	Pharynx	50	24 or 48%	12 or 24% (4 years and over)
New <i>et al</i>	Pharynx and larynx and tongue	176		32 or 18% (5 years and over)
Colledge	Larynx	79	33 or 41%	11 or 14% (4 years and over)
Clerf	Larynx	58		18 or 31% (5 years and over)

* It is to be remembered that most of the cases treated by roentgen therapy were extensive or late cases while most of the surgical ones were operable or early ones.

tion (one case, only 600 r to each side, the other, none at all) developed similar severe hemorrhages, so that it is my belief that the bleeding may have been due to inevitable infiltration by tumor and not to roentgen necrosis of vascular walls

Severe oral dryness with varying degrees of disturbance of taste occurred in several of the cases. One patient (No 14) complained that this disturbance of taste made him more miserable than the original tumor (a fungating tonsillar carcinoma, with cervical adenopathy). Slight atrophy of skin with patchy telangiectasis appeared in a few of the cases that received more than 4,000 r/air to one area.

Discussion—In cases in which the tumor has not almost entirely disappeared at the end of the planned amount of radiation, or when skin tolerance seems to have been reached, it is very difficult to decide how much more should be given. It is also difficult to treat patients as vigorously or as consistently as one would like to do. The great tendency in this work seems to be to "ease off" in dosage, this is well seen in Coutard's cases and is apparent from close

study of the detailed case reports of other authors. To refresh our memory on what Coutard has written under the heading "dosage and cancericidal effects" we transcribe the following from his 1932 paper

"To sum up, if the field is small and if the distribution of irradiation is accomplished in the maximum period of 15 days, we consider that the doses capable of provoking the destruction of epithelial cells correspond, for the skin, to 40 H (about 4,500 r), for the mucous membranes, to 35 H (about 3,500 r). These doses, which should necessarily be modified according to intervening infection, deep infiltration, or adherence to the cartilages, have permitted us to cure some cancers more easily because of their greater radiosensitivity. In order to attain these doses in the area of the lesion to be destroyed, we have been obliged to utilize, for the combined portals of entry, a total dose nearly double the preceding one.

"We have seen that in the treatment of pavement epitheliomas there is no relation, up to a certain limit, between the doses received and the frequency of cures, regardless of the degree of radiosensitivity. Our patients have been cured with doses between 7,000 and 8,000 r, or from 70 to 80 H. When the doses have reached 90, 100, and 150 H, there was no cure, on the contrary, aggravation of the patient's condition

TABLE VI—COMPARISON OF ROENTGEN TECHNIQS REPORTED*

Author	Lesion	K.V	Filter mm	Dist cm	Fields cm	Intensity and daily dose (r in air)†		No of fields	No of days of treatment	Total dose (all fields added—r in air)†
						r per min	r per day			
Coutard	Meso-pharynx	200	2 Cu or Zn 3 Al	60 av	10 × 15	3	180-480	2-4	17-40 (av 35)	4 000-6 500 (av 5 200)
	Hypo-pharynx	200	3 Al	60 av	10 × 15 to 10 × 20	3	180-480	2-4	8-47 (av 28)	3 500-6 500 (av 4 800)
	Larynx	200	3 Al	60 av	7 × 7	3	180-480	2	0-39 (av 18)	4 000-6 500 (av 5 000)
Schinz	Pharynx and larynx	200	2 Cu	50 av	?	3	300	2	15-32 (av 20)	6 400 av
Lenz	Pharynx and larynx	200	1 86 Cu 1 Al	50	6 × 8 to 10 × 10	10	300-450	2-4	16-44 (av 31)	5 600-9 400
Mattick	Larynx	200	3 Cu	50 to 80	10 × 15	15	140	1	15-?	2 000 up (one ant. field)
Maison	Pharynx Tonsil sa	200	2 Cu	65	?	3	400	2-3	21-35 (av 24)	3 500 av
		200	1 Cu	40	?		240-400	2-3	10-15	3 300 av
Kaplan	Pharynx and larynx	200	2 Cu 1 Al	60	10 × 15	5	400-500	2	21-30	6 800-8 800
Author	Pharynx and larynx	200	Thor	50 to 60	14 × 14 to 7 diam	32	100-300	2	12-60 (av 35)	6 000 av

* Many of these techniques have undergone considerable modification since the time they were reported, however they are of interest since most existing roentgen statistics are built from them.
† Recalculated where necessary from figures published with back-scatter. To obtain the approximate skin dose add 25 per cent to these figures.

and increased rapidity of recurrence have been the rule

"Under the conditions in which our treatments were conducted, the cancericidal effects did not increase proportionately with the doses, beyond a certain value

"Neither do the cancericidal effects increase proportionately with the time of treatment—quite the contrary. The real or apparent loss of radiosensitivity (immunization) of the cells of squamous epithelioma is often appreciable about the thirtieth day after beginning of the treatment. In the same way, the epithelial radiolesions of the skin and mucous membranes are more difficult to provoke (even when the doses are slightly increased) the longer the treatments have lasted."

Beside the proper total dose, the proper period of time over which the treatment should be given is difficult to decide. When visiting Coutard's clinic two years ago I observed him giving as little as 50 r per day, stating that he would continue treatment for as long as 14 weeks. He stated that he was giving as high as 7,000 r to one side of the neck and 5,000 r to the other. He admitted that his skin and mucous membrane reactions in these particular cases would not be nearly so marked as in his earlier cases and implied that his cures would possibly be fewer thereby. It is worth remembering that the classical Coutard epidermitis is produced by 4,500 to 5,000 r/skin given in 10 days of two daily sittings, each one hour long; the cutaneous epithelium is completely gone on about the twenty-seventh day and completely repaired on about the forty-second day.

Kaplan, *et al* (6) believe that under proper conditions the full course should be completed in 21 days, under such conditions the epidermitis will usually commence on the eighteenth day and terminate on the twenty-sixth, and epidermitis will commence on the twenty-sixth and terminate on the fortieth day. These authors believe that the extension of the treatment over too long a time, "that is, from 30 to 35 days," results in milder reactions and fewer cures.

How wide a field should be used? Realizing how much the general discomfort of the patient increases with the amount of radia-

tion given and the size of the field used, and yet remembering how important it is to use relatively large fields to secure adequate depth dosage as well as wide enough distribution of the beam, one has always to compromise on this question. On the whole, it would seem advisable, especially with pharyngeal cases and extensive laryngeal cases, to commence with a large field, at least on the same side as the lesion, in actual practice we have usually ended up with fields from 9 to 7 cm in diameter. With necks of average size and fields 10 cm in diameter, using the factors above mentioned, the amount of back-scatter to the skin is approximately 25 per cent. Since our estimations of back-scatter, tissue dose, and transmitted dose are all of questionable significance, we have not attempted to estimate actual tumor doses in the individual cases. When means become available to do this we shall attempt it, since it is obviously of considerable importance.

The major modification which we have been compelled to make in our technic (as compared to Coutard's) is in the r per minute intensity. Coutard (1), Schinz (8), Zwerg (9), and others believe that the r per minute intensity should be very low, not more than 5 r per minute. In addition, Coutard treats some of his patients twice a day so as to prolong the time under treatment. On the other hand, Pack and Qumby (10) on experimental grounds, and Lenz (11), Mattick (12), and other authors (13) on clinical grounds believe that satisfactory results can be secured with an intensity of from 10 to 30 r per minute. Most of our cases have been treated with an intensity of 32 r per minute.

A review of our small series of cases suggests that perhaps we should have treated some of them more rapidly, much more rapidly (e.g., 24 instead of 36 days) or that we should have given them larger doses (e.g., up to 4,500 r to each side). It is noteworthy that none of them suffered necrosis of cartilage or bone.

Other undecided but perhaps less important points include the question of the influence of wave length upon biological

effect. Since the results of both animal and clinical experimentation are conflicting, we must fall back on clinical impressions. There is no question but that the majority of workers favor thick filters, that is, filters giving an effective wave length of 0.12 to 0.11 Å. We have used a Thoraeus combined tin filter instead of 2 mm Cu because of its relatively increased efficiency (giving approximately 30 per cent more transmission than 2 mm Cu but a similar "hardness"). We think or imagine that the cutaneous reactions are less severe with it than with 0.5 mm Cu, but we realize that there are many who believe that the reactions are equally severe with either filter.

The question of pre-biopsy radiation is also a moot one. It is interesting to note a recent statement by a well-known nose-and-throat surgeon (14), urging that such should always be done. Personally, we regard it as a logical procedure.

Finally, the question of what constitutes the most judicious combination of radiation and surgery arises. Schinz (8) believes, as far as laryngeal tumors are concerned, that well-differentiated intrinsic epitheliomas with fixation of the cord can be treated surgically or radiologically. He thinks that all other laryngeal tumors should be treated radiologically. Like Coutard, he favors radiation in early cases on account of the better conservation of the voice. Coutard believes that when there is much infiltration of the laryngeal muscles, resection, followed by protracted roentgen therapy, will give better results on the whole than roentgen therapy alone. D. Harmer (14) advises, for operable tumors, a combination of short-course pre-operative radiation, surgery, and, starting about ten days later, long-course post-operative radiation. For all inoperable ones he recommends radiation only.

For pharyngeal tumors there is little doubt that radiation is the superior method of treatment. In early lesions the choice must depend on the facilities available and the relative skill of the surgeon and the radiologist. As Bloodgood (15) recently stated "X-rays are no longer looked on as

a last resort." One has only to see the results obtainable with properly administered radiation to suspect that the day of extensive mutilating operations is passing, no longer must one tell a patient that the only chance of cure in primary malignant disease of the oropharynx lies in an operation which may sacrifice half of the jaw. However, while proper radiation treatment requires as much judgment and care and considerably more patience than surgical treatment, Cade's remark that "competent surgery is still preferable to incompetent radiation" seems worth recalling to mind.

SUMMARY

Many cases of malignant disease of the larynx and pharynx can be arrested and apparently cured by adequate, carefully administered, roentgen therapy.

None of the present series of cases has been observed for a period of five years and, therefore, the number of "clinical cures" cannot be stated. However, it may be pointed out that 12 out of 24 cases showed primary healing, and 7 out of 24 cases are clinically arrested at the time of making this report (two months to one and one-half years) and that some of the others received remarkable palliation.

No patients died from causes directly attributable to the roentgen therapy in this series of cases. No late necroses of cartilage or bone and no laryngeal or pharyngeal obstructions due to radiation were observed.

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INTRA-ORAL CANCER AND ITS TREATMENT¹

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THIS subject is not a new one with us—it has been presented on two previous occasions (1 and 2)—but in this communication we are giving a review of the work carried out in the years 1930, 1931, and 1932. It was prompted by a recent report from the Curie Institute (3) and its purpose is to draw some conclusions that may be of future guidance in treating patients with this disease.

In order to facilitate the case analysis, patients have been segregated into two large groups. (A) Those in which there were lesions of the tongue alone, of which there were 69 cases, (B) Those in whom the malignancy was on the buccal surfaces, palate, and alveolar regions, of which there were 26 cases. For further ease in study these groups were subdivided into classes as given below.

TABLE I

Class I	Primary lesion less than 2 cm. in diameter
Class II	Primary lesion over 2 cm. in diameter
Class III	Primary lesion associated with enlarged lymph nodes
Class IV	Recurrent lesion after operation

Diagnosis—The diagnosis of malignancy in the oral cavity seems simple enough to an experienced observer but to the average physician it offers much difficulty. In early borderline cases confusion is bound to arise at times, but too often cancer is mistaken for acute inflammatory lesions such as trench mouth or for one of the manifestations of syphilis. In the minds of many men a smear or a blood Wassermann seems to clinch the diagnosis and suggest the treatment. Many patients are treated for weeks by local applications and intravenous arsenicals, even in the presence of an advancing lesion before a biopsy is even con-

sidered. It is excusable to treat a patient for a week or two but when no improvement takes place one may rest assured that something exists beside the condition for which treatment is given. When taking smears and blood for a Wassermann, why not make the biopsy a routine procedure? It is a simple one, carried out under local anesthesia, and from our observation as well as from the publications of others it does not seem to lead to dissemination where proper treatment is instituted immediately. After all, the absolute diagnosis rests on biopsy and biopsy alone, the sooner this lesson is impressed on the profession and laity alike, the sooner will we see earlier diagnosis and improvement in clinical results.

In the material we are studying we find that in Group A, biopsies were done in 47 patients, and in all of these a diagnosis of squamous-cell epithelioma was made. In Group B, we have 21 patients in whom a pathologic examination confirmed the clinical impression—all sections were put down as squamous-cell epithelioma except one, which was reported as a small round cell sarcoma. In the remaining patients, because they were in such an advanced state of the disease, the diagnosis was made by clinical examination alone—most of these individuals were not treated.

Prognosis—Prognosis is dependent on a number of factors, for instance, such associated complications as infection and syphilis are very important. Extensive purulent infections result in engorgement of the lymph vessels which favors early metastatic emboli into the nodes, diminishing the chances of cure. Syphilis also influences the outcome. In our patients, seven had a previous history of syphilis which was verified by a positive Wassermann. All of these patients were rather advanced in their disease but despite ener-

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis, Tenn., Dec. 3-7, 1934.

getic treatment both by radiation and electrosurgery, not one recovered

The two outstanding conditions of especial significance are the size of the lesion and the histologic picture. From the standpoint of extent of the lesion we have prepared Table II. Table III gives the influence of pathology

TABLE II

Group A	Cases	Well			Not treated	Dead
Class I	25	11	(44%)	(60%)	7	7
Class II	19	5	(26.3%)	(45%)	8	7
Class III	19	0	(0%)	(0%)	8	11
Class IV	6	2	(33%)	(49%)	1	3
	69	18			24	27

Group B	Cases	Well			Not treated	Dead
Class I	10	9	(90%)		0	1
Class II	5	4	(80%)		0	1
Class III	9	2	(22%)		0	7
Class IV	2	0	(0%)		0	2
	26	15			0	11

TABLE III

Group A	Cases	Living		Dead
Ungraded	28	10	(35%)	18
Grade I	5	4	(80%)	1
Grade II	12	3	(25%)	9
Grade III	1	0	(0%)	1
Grade IV	1	0	(0%)	1
	47	17		30

Group B	Cases	Living		Dead
Ungraded	11	10	(90%)	1
Grade I	2	1	(50%)	1
Grade II	5	4	(80%)	1
Grade III	1	0	(0%)	1
Grade IV	1	0	(0%)	1
Sarcoma	1	0	(0%)	1
	21	15		6

As a rule, the smaller the lesion, in the absence of secondaries, the better the chance of recovery. Likewise from a pathologic standpoint, the lower the degree of malignancy the less chance of metastasis and the greater the opportunity of recovery. High degree malignancies are not very common and rarely recover, but low grade malignancies, even in the presence of metastasis or recurrence when combined

electrosurgery and radiation are used, may be followed by recovery.

Treatment—The treatment of the primary lesion in these patients has been varied according to a number of conditions. Briefly, they are tabulated as follows:

- 1 Condition of the patient
- 2 Pathologic diagnosis and grading of the tumor
- 3 Extent of the primary lesion
- 4 Presence of metastatic nodes which are operable or inoperable

5 Presence of complicating diseases as marked secondary infection, syphilis, and diabetes

No hard and fast rules can be laid down, especially in the aged, since we must remember that though we are treating cancer we are also treating a patient. In some, palliation alone is all that can be hoped for even though the primary lesion is technically curable, since the general health precludes anything radical. On the other hand, a patient may be in excellent condition physically but the disease may be so malignant and extensive locally that curative and radical treatment is not justifiable. When conditions are favorable, we make use of radiation in any or all of its forms as well as electrosurgery. The methods which we have used are as follows: (1) Radon gold seeds alone, (2) Platinum radium needles alone, (3) Surface radium, (4) Electrosurgery alone, (5) Combined radiation and electrosurgery.

In the tongue, after extended use of both needles and seeds, we have come to the conclusion that seeds are preferable. We realize that this is not in accord with the views of some men in England, France, and this country who use needles to the exclusion of seeds. Needles do give a more constant and a better quality of radiation because of the higher filtration, but because the trauma incident to their insertion is greater, they carry a greater risk of infection than do seeds. The discomfort to the patient is more marked since they easily fall out and must be replaced. Seeds, on the other hand, are easily inserted and need not be watched. Furthermore, the

use of needles requires hospitalization, with its increased expense, an item of importance at present to every patient

Secondary Nodes —What should be done with suspected and palpable nodes is a big problem a question which was discussed in two previous publications (1 and 2) That a great difference of opinion still exists can be seen from the reports of the California Cancer Commission on this matter (4) This report represents a cross-section of world opinion on the subject by men who are engaged in this particular type of work In conformity with our previous opinions, we are still conservative in our attitude The lymph node has a definite function to perform, it acts as a barrier, and should be treated as such We do not feel that every case should have a radical neck dissection unless there are definite indications for it, since many patients do not develop nodes at any time As a general rule, we believe that each case should be individualized, but the following method is usually our accepted mode of attack

1 In the clinical presence of a primary lesion and no visible or palpable nodes in the neck, the lymph draining areas are given prophylactic irradiation by means of high voltage x-ray to each side of the neck The patient then reports for a check-up at stated intervals, if nodes develop, a neck dissection is advised The rationale of such a procedure is justified by the experience of Widmann (5), who found that in patients with epithelioma of the lip where no nodes were palpable only 17 per cent developed metastasis, while 51 per cent of the non-irradiated individuals developed uncontrollable cervical lymph node metastasis Prophylactic irradiation does not interfere with a later neck dissection if nodes develop and surgical interference is necessary The following case is illustrative

L B, aged 41 years, reported to the hospital on Feb 12, 1932, with a lesion on the buccal surface of the left cheek, 2.5×3 cm in size, which had been present four months No nodes were palpable Biopsy

showed squamous-cell epithelioma, Grade II

On Feb 15, 1932, 7 platinum needles with a total content of 10.1 mgm of radium were inserted under the lesion, giving a total dosage of 969.6 mg-hr over 96 hours In the latter part of March the lesion had completely disappeared He was then given x-radiation, a total dose of 1,190 r under the chin over a two-week period, with the following factors 30 cm, 100 KV, 4 ma, 0.25 mm Cu plus 1 mm Al filter Three nodes developed near the left submaxillary gland

In June, the submaxillary and submental regions were cleaned out by means of the endotherm, with primary healing The nodes showed the presence of metastasis In October, 1934, he was well

2 In cases in which the patient has palpable but not fixed nodes in the neck, both sides are treated with x-radiation If the section of the primary lesion shows a high grade of malignancy, only radiation is used In the lower grades, if the primary lesion is controlled and the nodes are still palpable, then the two procedures have been adopted

(a) *Radical dissection of the neck by means of the endotherm, followed by the implantation of platinum needles for a few days* —The following case is an illustration

J H P, aged 51 years, reported on Nov 9, 1932, with a lesion on the buccal surface of the right cheek, 2 cm in diameter and 0.5 cm thick, which had been present six months as a sore He had been treated for syphilis and trench mouth by two physicians On examination, besides the primary lesion, he had two nodes in the region of the right submaxillary region, the largest being 3 cm in diameter Biopsy showed squamous-cell epithelioma, Grade II

On Nov 17, 1932, six gold seeds of 12 mc were plunged around the growth of the primary lesion The mouth was healed on Jan 13, 1933

The secondary nodes were treated by x-radiation to the right side of the neck, 1,250 r, over a 10×10 cm area, from Nov

9 to 16, with the following factors 50 cm , 200 K V , 4 ma , 0.5 mm Cu plus 1 mm Al. On Jan 23, 1933, under Avertin anesthesia, a Butlin operation on the right side of the neck was done by means of endotherm. Four platinum needles were inserted around the digastric muscle, the total dosage for 72 hours being 288 mg-hrs. On March 22, 1933, no pathology was present. In October, 1934, he was well.

(b) *Exposure of the nodes and implantation of radon*—The following case is an illustration.

C P , aged 54 years, reported on June 2, 1932, that for six months he had suffered with a sore on the tongue which had been treated by carbolic acid. On examination, there was a lesion 3.5 cm long involving the entire left side of the organ, also, a node 1.5 cm on the left side of the neck over the carotid bifurcation. Biopsy showed squamous-cell epithelioma.

On June 10, 1932, 18 gold seeds containing 2 mc each were inserted into the primary lesion of the tongue. On September 30, the tongue was healed. The secondary lesion was given x-radiation over both sides of the neck, 1,200 r to the left side, 900 r to the right side, with the following factors 50 cm , 200 K V , 4 ma , 0.5 mm Cu plus 1 mm Al. Treatment was given from June 2 to 9, 1932.

On March 8, when the node did not disappear it was exposed by electrosurgery and 13 gold seeds containing 19.5 mc were inserted around and into the node. A severe reaction resulted but was followed by healing. In November, 1933, osteomyelitis of the left mandible developed which led to sequestration of the angle of the jaw. In October, 1934, the patient was in good condition except for loss of a part of the jaw, the tongue was healed and the node in the neck has disappeared.

3 In fixed inoperable nodes we have relied on x-radiation alone, radium packs, radon seed implants, or radium needles.

As a general rule in the patients we have studied, in whom the nodes in the neck are involved, x-ray and surface radium alone have not been sufficient to control the

disease even when the primary lesion is cured. We have, however, patients who have recovered when a combined radiological and surgical attack with or without the use of seeds and needles has been used. Whether the technic as described by Coutard will improve external radiation results remains to be seen. We have patients under observation in whom nodes have entirely disappeared after the use of his technic but the observation time is too short at present to offer any opinion as to the ultimate outcome.

Results of Treatment—Reference to Tables II and III gives the result of treatment. By careful selection of the method of treatment, many of these patients recover. The outcome is influenced to a great extent by the side of the lesion, its location, and the histologic picture. We cannot change the histologic findings nor the degree of malignancy, but we can by educational methods hope to influence the size of the lesion by earlier recognition. Laymen are prone to disregard trivial lesions in the mouth until quite advanced, but they alone are not to blame. The first medical adviser has often been an advocate of "watchful waiting" and has lulled the patient into a false sense of security which has pushed him out of the curable class into that of the incurable. Professional education will bring desired results if early biopsy is stressed in all doubtful cases.

SUMMARY

1 Improvement in the cure of intra-oral cancer may be expected where biopsy is carried out early. It gives the absolute diagnosis and suggests the type of treatment which must be varied to suit the individual.

2 Interstitial radiation, either in the form of gold radon seeds or platinum needles, for the primary lesion is the therapy of choice, it must be supplemented by electrosurgery where indicated.

3 Highly filtered x-radiation to the lymph-bearing areas and lymph nodes is indicated as a prophylactic in all cases, in those in which operable nodes are present,

x-radiation supplemented by radon implants to the nodes or electrosurgical dissection offer the patient the best we know of at present

4 X-radiation for palliative purposes is indicated in the inoperable group

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THE EVALUATION OF THE ROENTGEN TREATMENT OF LARYNGEAL CARCINOMA¹

REPORT OF CASES

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INTRODUCTION

THE evaluation of the therapeutic methods utilized for this disease is not an easy task. There are several reasons for this. Firstly, even to-day, the technic of radiation therapy has not yet been standardized. The results which any therapist is able to show at present are, therefore, in a sense experimental. Secondly, usually none but the most advanced and hopeless cases have been submitted for radiation treatment. The early intrinsic cases of carcinoma, cases which surgeons consider suitable for operation, are seldom subjected to radiation. Thirdly, there is much to be desired in the manner in which the results are summarized statistically.

Despite all this, such an analysis of the literature as is now possible would indicate that results obtained by radiation treatment in the advanced and hopeless cases are encouraging. Many sufferers have been rendered clinically free of the disease, or have had their lives prolonged in relative comfort. It is on the basis of experience, mainly, with this group, that the merits of radiation therapy as a means of controlling carcinoma of the larynx have been established. In the group not completely in the category of the inoperable, small as it is, the results obtained seem to warrant the statement that irradiation produces end-results as good as those obtained by surgical treatment, with the additional gain, the preservation of the voice. The combination of irradiation and surgery



Fig 1 Squamous-cell carcinoma with hornification partly necrotic

seems to give better results than surgery alone

ACHIEVEMENTS OF ROENTGEN THERAPY IN LARYNGEAL CANCER

Definite progress with this form of therapy is a very recent accomplishment. In 1922, Gunsett reported that he had treated two patients with high voltage x-rays, one remaining clinically free for a period of eight years. Ten years later (1932) he again reported, on a total of 33 cases (including the earlier ones), 23 being advanced and 10 intrinsic. One patient had lived nine years, two for four years, and five for three years—a total of nine survivals.

In 1922 also, Parès, in France, claimed to have cured five out of ten cases, and Pfahler utilized high voltage x-ray therapy before laryngotomy or other surgical measures. In 1923, Coutard and Hautant reported that 58 per cent of the patients

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Fig 2 Larynx from which specimen in Figure 1 was taken Aryepiglottic fold as well as the epiglottis shows induration and thickening Moderate amount of induration in the cuneiform and arytenoid cartilages Ventricular illumination fairly normal Both cords and bands can be clearly visualized



Fig 3 Complete disappearance of the tumor Normal laryngeal illumination and structural relation

they had treated by the x-ray had remained well for periods varying from six months to a year

Other reports from Coutard have appeared during the past four years Most of the cases treated were advanced and inoperable, and a goodly number of them were recurrences after surgery, many with metastasis to the cervical glands Of 77 larynx cases, there were 25 survivals for three years (32 per cent), and of 89 pharyngeal cases, 14 (15 per cent) were alive and well after three years This is by far the best result ever achieved in the radiotherapy of this particular lesion A report on the same series made in 1934 revealed that 22 (28 per cent) of the laryngeal cases still survived, and 11 (12 per cent) of the hypopharyngeal cases In both types of the disease there were survivals for more than seven years

Stewart-Harrison treated a total of 116

cases, of which 105 were pharyngeal carcinoma and 11 carcinoma of the larynx In 1932 he reported the results after three and a half years "Local success" had been attained in 57 pharyngeal cases (54.2 per cent), and 34, or 32.3 per cent, were clinically free from malignancy at the time the report was made Of the patients with carcinoma of the larynx, seven out of eleven showed the immediate success of the therapy, while six, or 54.5 per cent, were symptom-free when reported, from nine months to three and a half years later Stewart-Harrison concludes "The results of protracted fractional x-ray therapy in the treatment of cancer of the larynx and pharynx are not inferior, and are often superior, to those obtained by any other treatment"

Nager, Schinz, and Zuppinger, in 1934, presented their five-year results after using the method of protracted fractional dosage

In a series of 121 cases of very advanced and inoperable carcinomas of the pharynx and hypopharynx, they obtained success in 25 (20 per cent), while from 10 intrinsic cases, four (40 per cent) had been symptom-free for from two to five years. These authors believe that in small, localized, intrinsic tumors, roentgen therapy alone can produce primary regression of the lesion, and lasting results in a large percentage of cases.

Lambadarides, between 1925 and 1933, treated 12 cases of laryngeal cancer, all advanced and inoperable. When the report was made, six were alive and clinically free of all indications of malignancy. Of these, one has survived nine years, one, six years, one, five years, one, three years, one, two years, and one for one year.

This author attributes the good results principally to the employment of the fractional protracted radiation, but points out that such factors as natural resistance, the precise location of the tumor, and, to a certain extent, the histologic structure of the lesion play a part in the prognosis. As all of these patients would have died quickly without the assistance afforded them by x-ray therapy, he considers his results most encouraging.

RESULTS OF SURGERY

It is instructive to compare the above results with those obtained by laryngeal surgeons. It is generally conceded that in cancers arising from the vocal cords, the symptoms are manifested early, and the disease progresses very slowly. It is held, therefore, that surgery can produce permanent results in intrinsic cancer of the larynx. But in extrinsic cancer the onset is insidious, and invasion of the lymphatics takes place early also. Since, therefore, surgery offers very little hope for extrinsic cancer, the majority of cases coming to the radiologist are of this type—inoperable from the outset.

The surgeon selects his cases, and must take into consideration not only the eradication of the disease, but the preservation of the voice, as well. The radiologist, deal-

ing with the most advanced and inoperable cases, has succeeded in preserving the voice in all his cases, and has eradicated the disease to the extent of being able to show patients who have remained well for periods as long as eight and nine years. These facts should be kept in mind, in order to make a fair comparison between the results of surgery and of radiation.

Chevalier Jackson (1934) reports results of laryngofissure in early laryngeal cancer, as follows. Forty-one cases (55 per cent) alive and well after five or more years; nineteen cases untraced after the first year; three died within five years of intercurrent disease; two died of cancer of other regions without local recurrence; nine died of recurrence in less than five years.

From these results, Jackson claims 82 per cent of survivals for five years or more.

St. Clair Thomson (1928), also performing laryngofissure in early intrinsic cases, reports 70 operations, giving survival rates as follows. Thirty-four (45 per cent) alive and well for three years or more; eighteen died of intercurrent disease, having been free from cancer for three years or more; seven died of distant metastasis; eleven died of local recurrence; eight of these within one year; three died of recurrence after three years; three died as the result of the operation.

On the basis of the above, Thomson gives 76 per cent as the average of lasting cures.

New and Waugh (1934), of the Mayo Clinic, stressing the importance of early diagnosis, give the following results in 107 cases, in which the patients underwent thyrotomy or laryngectomy. Sixty-nine (64.5 per cent) were alive and well for five years or more after the operation. They also point out that of the six microscopically Grade 4 tumors, which they were able to trace, not one survived the five-year period.

Cetra, reporting 149 laryngectomies, gives the following figures. Thirty-seven (24 per cent) survived for three years or more; seventeen (11 per cent) lived for three years; nine (6 per cent) lived for four



A—Indirect mirror laryngoscopy showing the tumor mass involving arytenoid region and epiglottis at the beginning of roentgen therapy



D—At eight weeks continued regression of tumor mass



B—Four weeks following roentgen therapy showing the typical radio-epithelitis of the larynx and hypopharynx.



E—At fourteen weeks moderate amount of edema of the arytenoid region. The cords can now be well visualized and function normally



C—At six weeks definite regression of tumor mass



F—At 66 weeks complete disappearance of the tumor and restoration of the larynx to normal

Fig 4 Regressive changes in laryngeal cancer under roentgen therapy

years, and eleven (7 per cent) lived for five years. In 46 cases there was adenopathy, but in some the histologic examination failed to reveal cancer tissue.

of surgery in both intrinsic and extrinsic carcinoma of the larynx, as follows. In ten cases of early intrinsic carcinoma, the tumor being confined to the cord

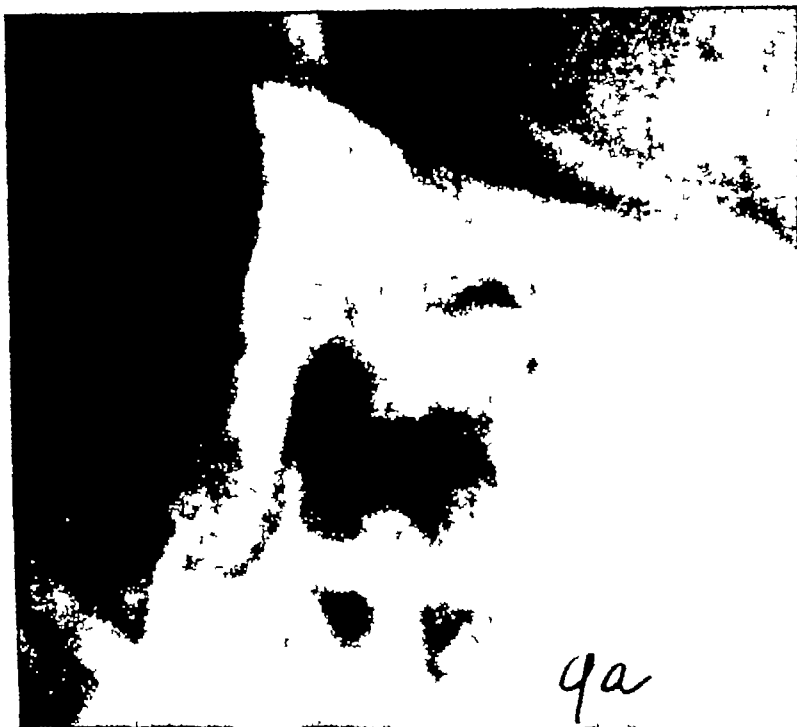


Fig 5 Infiltration of the aryepiglottic folds and erosion of the epiglottic cartilages. Infiltration in the posterior wall of the larynx and thyro-hyoid tissues. The hyoid bone is displaced upward. Laryngeal vestibule is encroached upon by the tumor mass. Laryngeal illumination is diminished.

The results of surgery in laryngeal cases are given by Nager, Schinz, and Zuppinger, of the Zurich Clinic. Some of their patients likewise received post-operative roentgen therapy by the old method of massive dosage.

There were 280 cases treated in all, of which 23 growths were intrinsic and 257 extrinsic. Eleven patients (5 per cent) survived from one to nine years. Of the six patients with intrinsic neoplasms who were among these survivors, two had received post-operative roentgen therapy. Of the remaining five patients who survived, the growths had been extrinsic, and of these two received post-operative radiation with x-ray and two (sarcomas) were treated with radium.

Fielding O. Lewis (1931) gives the results

and laryngofissure being the operation of choice, four (40 per cent) survived five years or more. In advanced intrinsic carcinoma, laryngectomy was performed in 83 cases. Of these, 32 (38 per cent) survived five years or more. In extrinsic carcinoma of the larynx, with cervical metastasis, out of 75 cases operated on, 16 (21 per cent) were alive and well after five years.

Taking the entire group of 168 cases in which surgery was the method of treatment, 52 (30 per cent) remained alive five years or more. This operator favors pre-operative and post-operative radiation in the advanced intrinsic and extrinsic cases.

Colledge and Peacock (1932) report the results of surgery in 108 cases of intrinsic and extrinsic laryngeal carcinoma, 56 out of 60 were operated upon, either by total

laryngectomy (42), partial laryngectomy (3), or laryngofissure (11). These authors claim 80 per cent survival in the cases in which thyrotomy was performed. The

cases, 30 being intrinsic and 82 extrinsic carcinomas of the larynx, wherein surgery was carried out. Twenty-five (22 per cent) survived, 20 of these survivors having been



Fig. 6 Same case as shown in Figure 5 showing normal roentgenographic appearance of larynx following roentgen therapy

time of survival is not definitely stated. Eleven (24 per cent) survived laryngectomy for three years or longer.

In the group of extrinsic cancers there were 48 cases. 24 were too advanced for surgery, one patient refused operation, pharyngotomy was performed in 23 instances. Nine patients (39 per cent) died as a direct result of the operation. Of the 14 surviving, eight lived for periods of from less than one year to two and one-half years, but eventually succumbed to the disease.

Orton (1932) operated on a series of 112

intrinsic cases. The time of survival is not given. Of the surviving five extrinsic cases, one has been alive and well for two years, one is alive, but with recurrence, and three are too recent to be reported as final results.

It is apparent, therefore, that conservative surgery as practised by Jackson, Thomson, New, and Clerf gives excellent results, but is applicable only to the very early intrinsic or cordal tumors, and in selected cases. Even in these, the results obtained are not without functional and physiologic disturbances of the larynx.

Jackson admits that only about 19 per cent of the cases which come into his hands are suitable for this kind of surgery

When the disease has become extrinsic, radical surgery is necessarily mutilating, the patient is permanently disabled and the consideration of the final results shows that the treatment is not warranted or justified. On the other hand, some surgeons report improved statistics in the results of operative treatment, when surgery has been combined with external radiation

SOME FEATURES OF DIAGNOSIS

From the point of view of diagnosis, prognosis and treatment it is important to establish accurately the location of the laryngeal growth

Direct and Indirect Laryngoscopy—Neither direct nor indirect laryngoscopy can give fully information as to the extent of the disease, and in the mirror a carcinomatous area always appears smaller than it really is, but if x-ray examination and laryngoscopy are combined, a more accurate picture of the disease is obtained

X-ray Examination—The careful study and interpretation of roentgenograms will supply many data which will prove most valuable in guiding the therapist in the selection of the method of treatment to be adopted. X-ray examination not only supplies information as to the extent of the neoplastic invasion, but also reveals much as to the spread of the disease into the prevertebral pharyngo-epiglottic space, the subglottic and hyoid regions, as well as into the soft tissues. The roentgen examination likewise shows the extent of involvement of the laryngeal cartilages

The roentgen examination may be made fluoroscopically or radiographically, or both methods may be employed. The fluoroscopic examination permits a preliminary general survey, and also a study of the mobility of the structures during phonation, deglutition, and respiration, while the routine roentgen examination provides the permanent record

The alterations in the larynx and ad-

jacent parts produced by an intrinsic or extrinsic malignant neoplasm are visualized in the roentgenogram as erosion, infiltration, and displacement of both larynx and neighboring structures, as well as by obliteration or encroachment on the illuminated pharyngo-laryngeal spaces

While treatment is in progress, and after its completion, roentgen examination gives information as to the reaction of the tissues to irradiation, and aids in determination of the dosage. After the treatment has been concluded, the x-ray examination permits the study of the progress of regression, and the detection of early metastasis or recurrence

Biopsy—The question of the wisdom of performing biopsies has long been a subject of lively discussion among those interested in the treatment of cancer of the larynx. Thomson thinks the clinical examination is far more important, and that many of the specimens taken are not large enough, also, at times, that the tissue may be, not only insufficient, but removed from the wrong place. Tucker, on the other hand, strongly advocates biopsy, regarding it as the conclusive diagnostic step in every case. He advises the use of the Jackson laryngoscope, for when this is employed a specimen from any desired site can be obtained promptly and accurately. Clerf believes that the factor of biopsy as an influence in promoting metastasis is largely theoretical, although he recognizes the possibilities of trauma at the time the laryngoscopy is done, and that to permit a long interval to elapse between taking the specimen and instituting treatment favors dissemination of cancer cells. Therefore, trauma and delay should be avoided

RADIOSENSITIVITY

Although, generally speaking, the histologic examination and the grading of tumors provides valuable information, it must be stressed that there are numerous other factors which play an important rôle in the "radiosensitivity" or "radio-curability" of the individual tumor. Success in treatment depends upon the care-

TABLE I—CLASSIFICATION AND RESULTS IN THE ROENTGEN TREATMENT OF 13 CASES OF LARYNGEAL CARCINOMA

LIVING

Name Age	Symptoms— Duration	Location of Lesion	Cervical Glands	Type of Lesion	Histology	Dose and Time of Treatment	Immediate Result	Final Result
1 H Z 48	Hoarseness—15 mos	Ant commissure and ant half r cord	Not palpable	Intrinsic	Squamous-cell carcinoma with hornification	8 820 r (33 days)	Complete regression of tumor voice normal chin wide	Alive and well (44 months)
2 J P 67	Hoarseness—1 yr dyspnea 3 weeks	Tumor involving almost entire r cord and partially obstructing laryngeal vestibule	Not palpable	Intrinsic (advanced)	Squamous cell carcinoma with little and incomplete hornification	8 700 r (24 days)	Complete regression of mass voice normal chin wide	Alive and well (44 months)
3 A S 76	Hoarseness dysphagia—15 mos Rad pain to head 6 mos Lar obstruction and tracheal stricture (July 15 1931)	Large mass filling larynx and extending to pyriform sinus and folds Complete obstruction of larynx and partial obstruction of pharynx	Palpable on l side	Extrinsic	Squamous-cell carcinoma	5 040 r (23 days)	Rapid and progressive regression of tumor removal of tracheal cannula and restoration of voice alleviation of symptoms chin and voice normal	Alive and well (39 months)
4 B B 66	Hoarseness and dyspnea and dysphagia	Ulcer and infected tumor mass in r laryngeal vestibule r arytenoid r aryepiglottic fold r vent. band	Right cervical palpable	Extrinsic	Squamous-cell carcinoma with little hornification	8 400 r (27 days)	Rapid and progressive regression of tumor with alleviation of symptoms voice normal chin wide	Alive and well (36 months)
5 P V 60	Hoarseness dysphagia—6 months	Ulcer and infected tumor mass epiglottis folds r band and pyriform sinus arytenoid Cartilage invasion	Palpable on r side	Extrinsic	Squamous cell carcinoma markedly anaplastic	8 064 r (28 days)	Rapid regression of tumor mobility of cords reestablished	Alive and well (24 months) complete regression of tumor and adenopathy

DEAD

Name Age	Symptoms— Duration	Location of Lesion	Cervical Glands	Type of Lesion	Histology	Dose and Time of Treatment	Immediate Result	Final Result
6 M 65	Hoarseness—5 mos dysphagia—2 mos	Tumor mass involving r lar vest. r vent. band r cord post. half and r ventricle. Infiltration post pharyngeal wall and post cervical region	Not palpable	Extrinsic	Papillary carcinoma with pearl formation	9 900 r (48 days) treatment interrupted	Incomplete regression of tumor and presence of edema after first series of treatments complete regression of tumor and edema after second series voice normal chin wide	Clinically well (36 months) recurrence—tracheotomy infection and laryngeal necrosis died
7 H P 68	Hoarseness dysphagia and dysphonia—2 mos	Large ulcer on l side of larynx involving larynx and epiglottis	Palpable on l side	Extrinsic (advanced)	Squamous cell carcinoma	8 250 r (17 days)	Incomplete regression of tumor infiltrating and ulcerating mass persistence of laryngeal edema improvement of symptoms (6 mos) recurrence and necrosis of cartilages	Died 14 months after treatment
8 M 49	Hoarseness dysphagia—2 yrs	Ant commissure r half base epiglottis r cord r vent band induration in prevertebral space	Both submax glands enlarged	Intrinsic (advanced)	Squamous-cell carcinoma with hornification	8 500 r (19 days)	Eventual regression of tumor but persistence of laryngeal edema symptoms improved lasting 10 weeks laryngeal edema increased and tracheotomy	Died one year after treatment autopsy laryngeal necrosis no evidence of carcinoma

9	Hoarseness dysphagia in 1st r and head —6 mos	Epiglottic fold base of tongue and pharyngeal wall 1 vent band and cord Induration in prevertebral space	Bilateral	Extrinsic (advanced)	Squamous-cell carcinoma with hornification	8 470 r (28 days)	Regression and arrest of tumor growth with alleviation of symptoms and improvement in general condition (about 4 1/2 mos.) recurrence of symptoms and activity of growth lar edema tracheotomy	Died 10 months after treatment
10	A D 72 Dysphagia and hoarseness—0 wks pain 1 ear—3 wks	Tumor of 1 pyriform sinus phar and lar wall 1 aryepig fold and band Mobility of 1 cord impaired Edema of epiglottis	Not palpable	Extrinsic	Squamous cell carcinoma	8 400 r (24 days)	Complete regression of tumor and alleviation of symptoms lasting 7 mos gradual recurrence of dysphagia and laryngeal edema tracheotomy	Well 7 months then recurrence tracheotomy in April 1932 untraceable
11	J B 70 Hoarseness—5 wks	Tumor located on ant part of right cord	Not palpable	Intrinsic	Papillary squamous cell carcinoma with numerous mitoses and anaplasia	9 300 r (52 days) treatment interrupted	Slow regression of tumor but persistence of laryngeal edema which eventually caused laryngeal obstruction tracheotomy and gastrostomy (fifth week) sloughing of tracheotomy wound and evidence of cartilage necrosis	Died 4 months after treatment cardio vascular disease
12	A C 48 Dysphagia hoarseness	Ulcer and infecting tumor mass involving epiglottis pyriform fossa Chink narrowed cords not seen Tracheal cannula in situ	Bilateral cervical palpable	Extrinsic (advanced)	Squamous cell carcinoma with hornification	8 400 r (28 days)	Incomplete regression of tumor and arrest of progress of growth alleviation of symptoms of pain and dysphagia for 3 months	Improved for 3 months recurrence alive with recurrence and necrosis died 8 mos after treatment
13	H B 42 Hoarseness dysphagia—3 mos Lar pain and rad pain to 1 ear—2 mos	Ulcer and infecting tumor mass involving pyriform fossa epiglottis and aryepig fold Mobility of 1 cord impaired Tracheotomy	Palpable deep and superficial chain involved	Extrinsic	Squamous cell carcinoma with hornification	7 680 r (28 days)	Regression of tumor and edema of pyriform fossa and tracheal cannula removed eventual spread and involvement of larynx and hypopharynx	Died with recurrence metastasis and involvement of deep and superficial glands and hypopharynx after treatment

ful consideration of many factors, such as the extent of regional metastasis, the size and location of the primary tumor, the amount of involvement of the cartilages, the presence or absence of secondary infection, the condition of the vasculo-connective tissue about the growth (tumor bed), the technical or physical factors in the treatment (time-intensity factor, etc.), and the patient's general physical state. These factors are as important as the histologic structure of the tumor, upon which so much stress is commonly placed.

Our conceptions of what constitutes radiosensitivity, or radioresistance in tumors, have recently undergone considerable modification. While histologic grading is undoubtedly very useful, work such as Coutard's, Schinz's, and Zuppinger's, and our own clinical experience, have definitely demonstrated that laryngeal growths (histologically squamous-cell epithelioma with hornification, which is usually found on the true vocal cord, and long considered to be highly radioresistant) can be made to yield readily to roentgen therapy, if the energy is distributed in relatively low intensities and the treatment protracted over a long period of time. Indeed, after consideration of all factors known to play a rôle in radiosensitivity, we still cannot predict precisely how any given tumor will behave under irradiation.

TRACHEOTOMY

In our experience, tracheotomy has never been necessary during the course of treatment. If the chunk of the glottis is

much narrowed, so that when the patient first comes under observation dyspnea is marked, or there is edema of the soft tissues, tracheotomy should be done before treatment is instituted

This does not mean however, that tracheotomy should be done as a routine, but, rather, the contrary. Only when edema and congestion of the mucous membrane seem likely to threaten asphyxiation is it necessary, but the decision must be made *before* the radiation is undertaken

In laryngeal tumors, especially if they are subglottic, a low incision, opposite the second and third tracheal rings, will be found best. If the lesion lies below the glottis, there is danger when making the incision of cutting into the tumor itself, and opening up an avenue for infection and the spread of the disease

When the patient has been tracheotomized before irradiation is instituted, the cannula should be removed before each treatment, and afterward replaced. This is important, because if it is left in place during treatment, the secondary radiation from the metal tube will cause marked local reaction, and may produce necrosis of the cartilage

RADIO-BIOLOGIC PRINCIPLES

The principles underlying the modern concept of the technic of roentgen therapy are based on considerable biologic experimentation (Regaud and Blanc, Regaud and Nogier, Regaud and Ferroux, Schinz and Slotopolsky, Lacassagne), and practical clinical research (Coutard, Pfahler, Schinz, Berven, Zuppinger, Hirsch). It has been demonstrated beyond question that greater differential effects can be produced, as between the tumor cells and the cells of the adjacent and surrounding tissues, by the administration of radiation at a slow rate. Consequently, the desired biologic reaction in the tumor and normal tissues depends not only on the total energy delivered, but also on the rate (intensity/min) at which it is delivered to the tissues

By delivering the radiation at a relatively slow rate it is possible to give large

doses of hard rays, and to produce destruction of the epithelium of the skin and mucous membrane and reactive changes in the vasculo-connective tissues (tumor bed), with complete restitution of the normal tissues—a reversible reaction—while the effect on the neoplastic cells is permanent—irreversible

Before considering the technic of the irradiation it is important to emphasize that though there are definite general principles underlying this treatment, each case is more or less an exception to the general rule. Success depends on the careful daily examination of the larynx during the treatment. The reaction of the normal mucous membrane of the larynx, as well as the response on the tumor tissue, permits modification of routine which each particular case seems to demand

TECHNIC OF IRRADIATION

Though the treatment by the x-ray would seem to be a relatively simple matter, experience has shown that malignant growths in this particular region present many technical problems, so that even partial success can be attained only by the most scrupulous attention to every detail

We use two constant potential, kenotron rectification power plants. One is a Wappler Quadrocondex machine and the other a Stabilivolt apparatus. The tubes are the Philips Metalix water-syphon cooling type, overhead suspension. The voltage used is 180 K V, 4 ma, 60 cm skin-target distance, 2 mm copper plus 1 mm aluminum filtration. The half value is 1.85 copper, the effective wave length (λ_{eff}) is 0.11 Å. The depth dose (10 cm) is 36 per cent and the intensity is 6.4 r per minute on the surface

Fields of Irradiation—It is necessary to irradiate not only the local lesion but the regional lymphatic basin as well, even though no adenopathy is present. Accordingly, the portals are somewhat larger than those usually utilized, averaging between 100 and 125 square centimeters

The portals comprise the right and left

cervical areas The boundaries of the fields are the clavicle below, and the lower border of the ramus of the mandible above, the median line of the thyroid in front, and the posterior border of the sternomastoid muscle posteriorly

Dosage—The mucous membrane reaction—both the time of its appearance and its intensity—may be used as a biologic control of the dose

A good reaction of the mucous membrane appears to be associated with a satisfactory regression of the tumor A too rapid completion of the total dose, or a too large daily dose, may result in permanent destruction of the vascular connective tissue with cartilage necrosis, incomplete sterilization of the neoplasm, laryngeal edema, and rapid recurrence

In the cases in which good results were obtained, the total dose varied from 5,000 r on the surface, given over a period of 23 days, to a maximum of 8,600 r in 33 days Treatments are given daily, six times a week In the cases that have died the dosage varied between 6,400 r in 24 days to a maximum of 9,900 r in 48 days

The criteria for sufficient dosage is the evidence of complete destruction of the mucous membrane of the laryngo-pharynx or, as commonly known, a homogeneous radio-epithelitis

When because of syphilis, diabetes, arterio-sclerosis, or chronic cardio-renal disease, the mucous membrane reaction is atypical, the reaction of the epidermis of the skin is the guide Dosage sufficient to produce complete exfoliation is administered

CLINICAL MATERIAL

Our material consists of 13 cases of histologically proven laryngeal carcinoma, treated between 1929 and 1932 All the patients were men The youngest was 35 and the oldest 72 years of age

From the histologic point of view, all lesions were squamous-cell carcinoma Nine showed various degrees of hornification, two showed anaplasia, and in the remaining

TABLE II—ANALYSIS OF CASES

	Intrinsic	Extrinsic	Palpable	Hornification	Histology—Squamous-cell Epithelioma	
					No	Hornification
Alive (5)	2	3	3	4	1	0
Dead (8)	2	6	5	5	1	2
Total (13)	4	9	8	9	2	2
Ages of patients		35 to 72 years				
Sex		all males				
Most common symptoms		hoarseness, dysphagia				

TABLE III—RESULTS

	Total	Alive and Well 24-44 months	Dead
Extrinsic	9	3 (33%)	6
Intrinsic	4	2 (50%)	2
Total	13	5 (38%)	8

two there was no evidence of hornification or pearl formation

The most common symptoms were hoarseness and dysphagia

There was definite cervical adenopathy in eight cases The adenopathy usually corresponded to the side of the lesion The very advanced cases presented bilateral cervical adenopathy, and the superficial, as well as the deep cervical, chain of glands were involved

In three cases, before treatment was given, tracheotomy had to be performed as an emergency procedure, to prevent death by asphyxia One of these patients is now alive and has been well for three and one-half years

There were four intrinsic and nine extrinsic cases Even in the intrinsic lesions, the involvement and anatomical location were such that they were not suitable for conservative surgery (thyrotomy)

In all, definite regressive changes took place and in practically all, the tumor primarily disappeared

Eight patients have died Two of these were intrinsic, and six extrinsic cases One of these patients lived three years in comfort, and was free of the disease Recur-

rence, with ulceration and infection and adenopathy, then took place. The patient was retreated, but laryngeal edema set in and tracheotomy had to be performed. This patient subsequently died of general sepsis and cartilage necrosis. In the other fatal cases recurrences were observed between the fifth and twelfth months. In one death from laryngeal edema, permission was obtained to remove the larynx and a careful histologic examination was made of the entire organ. There was no evidence of carcinoma in any of the sections.

Of the five patients alive and well, two cases are intrinsic and three extrinsic. From the clinical and histologic points of view the prognosis in these cases was unfavorable, because of the extension of the disease, cervical adenopathy, and the microscopic finding of hornification and pearl formation.

Two patients are alive and well with no clinical evidence of disease, and have good function of the larynx after forty-four months. One case was retreated after eighteen months, because of suggestive symptoms of reactivity (slight dysphagia, moderate edema of the arytenoid region). All these symptoms have cleared up following the second series of roentgen treatment. The patient is now alive and well, twenty-four months since the initial series of treatment.

SUMMARY

The roentgen examination is a valuable aid and guide in the diagnosis and treatment. It aids laryngoscopy in giving an accurate picture of the disease.

Biopsy, when followed by treatment within a reasonable period of time, does not predispose to metastases.

Tracheotomy is a life-saving procedure in advanced cases with total obstruction of the larynx, and should in selected cases be done before instituting treatment. Routine tracheotomy, in cases in which there is no evidence of marked laryngeal obstruction is not indicated.

The failure to obtain a clinical cure appears to have been due to several factors

- 1 The nature of the lesion. The advanced and unfavorable condition of the case, with involvement of the deeper structures of the larynx, muscles, perichondrium, cartilages, and superimposed infection—all these factors acting in such a way as to make it impossible to obtain more than temporary alleviation.

- 2 Faulty technique

- 3 Systemic state

General debilitating diseases, old age, cardio-renal disease—contribute to the production of an atypical mucous membrane and skin reactions and thus complicate the estimation of the proper dosage.

CONCLUSIONS

On the basis of analysis of the literature on the results of the evaluation of the surgical and roentgen treatment of laryngeal cancer, as well as the study of 13 cases of our own, it may be stated that—

- 1 In intrinsic cases clinical cures can be obtained by roentgen treatment in cordal, glottic or subglottic, non-infiltrating, keratinizing, fully differentiated squamous cell epitheliomas. In such cases surgery gives equally good results, but with a lesser degree of conservation of function and with an average operative mortality of about 15 per cent.

- 2 In the extrinsic cases in which the tumor involves the epiglottis, glosso-epiglottic folds, valleculæ, pyriform sinus, hypo- and lateral pharyngeal and post-cricoid regions the prognosis is usually unfavorable due to the tendency to rapid spread and metastatic glandular involvement. In this group surgery gives a high mortality and offers no assurance of cure. Roentgen therapy can produce a clinical cure in this group with cervical involvement, or, if the case is hopelessly advanced, palliation, comfort, and prolongation of life.

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DISCUSSION OF SYMPOSIUM ON MOUTH AND NECK¹

Dr MAX CUTLER (Chicago) I appreciate the privilege of discussing Dr Meland's paper. The prognosis of intra-oral carcinoma is dependent upon two factors—the extent of the disease and the histologic structure. The question of prophylactic radiation in the absence of clinical evidence of disease in the neck I think constitutes an extremely difficult problem. My present feeling is against using any form of prophylactic radiation for the cervical area when there are glands to be found on clinical examination.

In that respect I agree with the principles of the French school, taking the position that when prophylactic irradiation is administered under these circumstances, the skin is so altered and injured that a subsequent complete adequate irradiation becomes impossible if or when lymph nodes subsequently appear. This reason, added to the well-known fact that metastases do often appear in the face of such prophylactic irradiation, has led me to adopt the procedure of not irradiating the neck, prophylactically in intra-oral cancer.

I use seeds in areas in the tongue that are difficult to treat by removable platinum needles, as, for example, at the base of the tongue. On the other hand, I have found no difficulty whatever in retaining removable platinum needles in place by suturing them. If each needle is sutured in place, there is no difficulty in retaining them in position.

I was exceedingly interested in the paper on carcinoma of the larynx. I believe there are three problems with which we are confronted at present in the treatment of carcinoma of the larynx: first is the group in which the lesion is limited to the vocal cord, second, the group in which the lesion has infiltrated beyond the cord but is essen-

tially an intrinsic lesion, third, extrinsic carcinoma of the larynx.

Concerning the last group, there is no difference of opinion amongst surgeons and radiologists that radiotherapy is the method of choice. So far as the first group is concerned—lesions limited to one vocal cord—I am convinced that if proper radiation facilities are available and the individual using them has had adequate experience in their use, protracted radiation according to the Coutard method constitutes the method of choice as the initial treatment.

The intermediate group of cases, or that group in which the lesion begins as an intrinsic carcinoma but soon infiltrates the muscles and cartilage, constitutes a very difficult problem at the present time. This is the group in which radiation, even by the Coutard method, has yielded a very small percentage of cures. There is a great question as to the therapeutic method of choice in this rather large group of cases because, once the muscles and cartilage are infiltrated, radiation has usually failed. My present attitude concerning the treatment of carcinoma of the larynx is to use protracted irradiation for localized carcinoma of the vocal cord, protracted radiation for extrinsic carcinoma of the larynx, but until we have further evidence, laryngectomy for intrinsic carcinoma of the larynx which has infiltrated the muscles or cartilages when no contra-indications to operation exist.

Concerning Dr Garland's paper, Coutard is at present protracting his treatment over a longer period of time rather than diminishing the time of treatment. I think Dr Garland is to be congratulated on his courage for persisting in the treatment of such an advanced group of cases. Even 16 per cent control is excellent in a group in which such a high proportion are advanced.

In my opinion the radiation has been administered too rapidly and through too large a field in Dr Garland's cases. I understood that 32 r units were given per minute through a field 14 × 14 centimeters in thirty days. I think that this radiation is too intense. I would advise rather than shortening the time of irradiation that the

¹ The paper by George E. Pfahler, M.D., entitled 'The Treatment of Epithelioma of the Cheek,' was read by title and published in *RADIOLOGY*, January 1935, 24, 99-109.



Fig 1

time of irradiation be protracted and that the fields be reduced in size so that the intensity of treatment is diminished

DR JOHN S DERR (Frederick, Maryland) I have one case I would like to report. It is a case of cancer of the tongue in a man 58 years of age. When he was first seen in 1929, there was a small growth far back on the side of the tongue. This was treated with electro-coagulation and low voltage x-rays through the neck and jaw. About three years later he returned with an increased growth. Dr Merritt, of Washington, who saw him in consultation with me, inserted six radium needles around the mass. He received a heavy dose of high voltage x-rays through both sides of the neck before and after the radium treatment. Results in 1932 are shown in Figure 1. There has been no recurrence.

DR ROBERT S STONE (San Francisco) In connection with the Coutard method, I would like to ask the essayists in their

closing remarks to take up with us the point that Dr Cutler introduced in his discussion about protracting to a greater period of time.

As I understand the commencement of Coutard's method, it was the result of Regaud's experiments on the testicles of rabbits. He decided that the proper time in which to treat these rabbits' testicles to get the best result was from four to nine days. Now, of course, the life cycles of tumor cells may be entirely different from the life cycle of the cells in the testicle of a rabbit. We do not know the length of the life cycle of any particular tumor and probably if we were able to determine that we would know better how long to treat these patients.

However, it seems to me, in watching these patients who are treated with the protracted fractionated dose, that if we give a good heavy dose they get their mucous membrane reaction in from ten days to two weeks.

A tumor that arises from the mucous membrane, it seems to me, would have somewhat the same type of life cycle as the mucous membrane from which it arises, if anything, somewhat shorter. Therefore, it would seem on hypothetical grounds that we should give the treatment in from ten days to two weeks instead of drawing it out to a matter of several months.

I may be mistaken but it is my understanding that Coutard's results since he has been protracting his treatment to a longer period are not so good as they were in the early days when he gave them in a shorter period of time.

Of course, the other problem is that we are dealing with a patient as well as a tumor, and it may be that the patients will be unable to stand the dose that would be administered in a shorter period of time. Watching these patients, however, both as regards the mucous membrane and as regards their skin, and seeing both surfaces react severely and then recover while you are continuing to administer daily doses of roentgen rays, makes one feel that the tumor can probably do exactly the same thing. While we are going on giving the radiation, the tumor may have recovered from its reaction and returned to its normal growth.

One other point I would like to bring up is the question of prophylactic radiation of the neck. I think that if we are going to do prophylactic radiation of the neck, we should not do it in any half-hearted way as if we are going to put a little radiation on there in the hope that it might stop a cancer coming. We have to treat the neck under the assumption that there is some cancer there, so microscopic we are unable to feel it. If there is none there, then Dr. Cutler is right—there is no point in giving radiation. If there is some there, then a mild dose applied to the neck is of no use whatever. We have to either give no radiation to the neck or we have to treat it as if we imagined a cancer there, and give it a full dose.

DR. O. N. MELAND (closing): I am glad

the question of prophylactic radiation has come up. As you remember, I told you I did not know how much good prophylactic irradiation did. However, I know this: That we have not controlled the malignancy in any of the neck cases by the ordinary methods of irradiation. We also know this: When we give 1,200 r and wait six or eight weeks, we are still able to do a neck dissection with primary healing.

If you are going to give your patient a full radiation dose under the assumption that you are dealing with a malignancy even though nothing is palpable, I doubt very much whether the patient will go through any surgical procedure in the line of a neck dissection.

I did not go into the matter of technique to any extent. You all know how to treat these patients. The only reason why I wanted to present the paper was to emphasize the necessity of having these patients sent to you when the lesion is small. If you take home nothing more than this, do take the necessity for treating patients when the lesions are curable.

It is up to us as consultants to go back to our general practitioners and to our dentists and urge them to institute a campaign on the necessity of biopsy in all doubtful cases in which there is a lesion involving the tongue or the internal surfaces of the mouth.

DR. BAUM (closing): We use somewhat larger fields than have been pointed out by Dr. Cutler: our average cervical area is about 100 square centimeters. We do this because we feel that even in the early cases in which no cervical metastatic glands are palpable, there is no such thing as being certain that cancer cells have not invaded the regional lymphatic drainage basin. The larger field will irradiate not only the local lesion, but the regional lymphatics as well. In advanced cases with definite unilateral or bilateral cervical glands we use larger fields—125 to 140 sq. cm.—irradiating the entire cervical area from one mandible to the clavicle. By protracting the treatments over a longer period of time—

40 to 50 days—we can give large dosages, resulting in complete exfoliation of the skin, but with complete restoration *ad integrum* in a period of a fortnight. We have seen definite metastatic glands regress completely under this form of treatment, and in spite of the large dosages some of the patients have received there is no telangiectasia or atrophy after observing some of these cases for over three years.

In reference to Dr Meland's paper we also use platinum needles in the anterior two-thirds of the tongue. In the posterior region of the tongue, however, we use removable platinum radon seeds filtered by 0.3 or 0.4 mm of platinum. We prefer seeds because they can be deposited more accurately and because they can be more adequately held in place.

DR L H GARLAND (closing) In answer to Dr Cutler I may say that we use only large fields with extensive pharyngeal lesions. The fields vary in size in every case, one patient being treated with fields as small as 7×5 centimeters. The length of treatment in days also varies considerably, one of our cases was treated in 13 days, one in 80 days, the majority were finished in 36 days.

One of the Doctors asked me a question about the r per minute. This has usually been approximately 30. This is, of course, a marked departure from Coutard's technique, however, under circumstances in which it is necessary to treat many patients each day it would be almost impossible to use only 5 r per minute.

A RADIO FREQUENCY HIGH VOLTAGE APPARATUS FOR X-RAY THERAPY¹

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Division of Roentgenology of the Medical School and the Radiation Laboratory of the Department of Physics, University of California²

PART II

IN THE previous issue of this Journal a radio frequency high voltage apparatus for x-ray therapy was described. The construction of the apparatus, as can be determined from the previous description, is such that the high voltages

complete absorption curve, (2) the "equivalent voltage" of Lauritsen, (3) the constant potential equivalent of Taylor, (4) the half value layer, (5) the effective wave length of Duane, and (6) the average wave length. The effective wave length and the average wave length methods are not used in the range of voltages here described

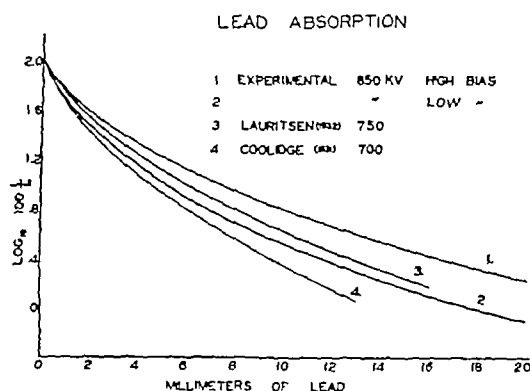


Fig 7 Curves of absorption by lead

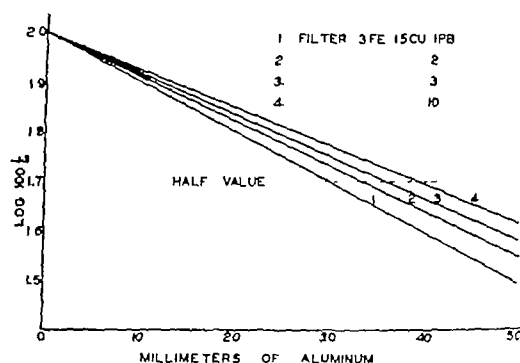


Fig 8 Curves of absorption by aluminum

are made and kept within a vacuum tank. Therefore, it is not possible to measure the peak voltages by the usual sphere gap method or by a voltmeter.

It is necessary, therefore, to state the quality of the radiation. The commonly adopted methods of specifying the quality of an x-ray beam are the following: (1) the

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis, Tenn., Dec 3-7, 1934.

² We wish to acknowledge the generous support of Mr. William H. Crocker of San Francisco, which has made this installation possible. The Christine Breon Fund for Medical Research has contributed some of the funds for the investigations. The original development of the method was largely supported by the Chemical Foundation and the Research Corporation. The advice and assistance of Professor E. O. Lawrence, of the Physics Department and Professor H. E. Ruggles, of the Division of Roentgenology have been of inestimable value.

Method of Obtaining Percentages of Absorption—A lead diaphragm 2.5 cm thick, with a circular aperture 2 cm in diameter in its center, was placed just outside the wall of the tube at a distance of 42 cm from the target. A second similar diaphragm was placed at the entrance to a lead cylinder 12 cm in diameter and 60 cm long. Thus a beam of rays could be directed down the axis of the lead cylinder so as not to touch its walls. An aluminum ionization chamber, 1.4 cm long and 7 cm in diameter, with walls 0.3 mm thick, was placed at the far end of the lead cylinder. It was connected to a string electrometer (Fricke-Glasser dosimeter). The quantity of radiation was measured by the time taken for the indicator to pass over the complete scale.

The influence of scattered radiation from the room was largely eliminated by taking initial readings with the entrance to the

must be near the peak of the applied voltage. The effect of applying various grid-bias voltages on the shield of the

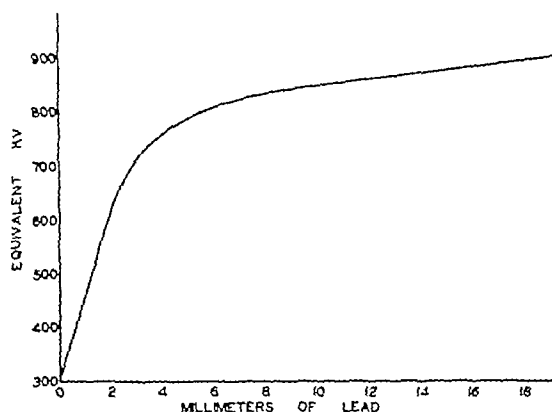


Fig 9 Curve showing the increase of "equivalent voltage" with increase of lead filtration

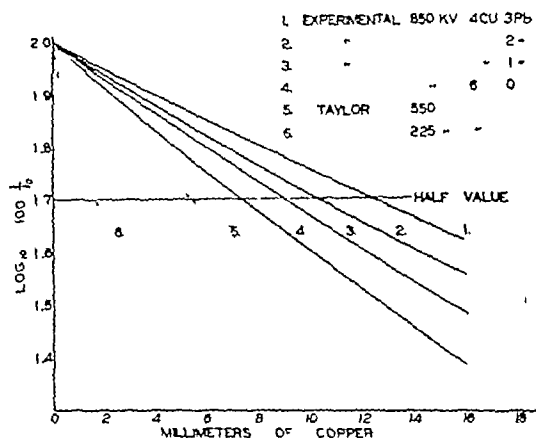


Fig 10 Curves of absorption by copper

lead tube blocked by 10 cm of lead. The wall of the tube consists of 0.5 mm of copper plus 3 mm of steel, both of which constitute a permanent initial filter.

Complete Absorption Curve—Lead is the absorber usually used for obtaining curves up to nearly complete absorption in the high voltage range because the total thickness required need not be more than 2 centimeters. The physical data concerning the absorption in this metal are complicated by the photo-electric effect, whereas those for the lighter elements are not. Therefore, it is less convenient for the estimate of the equivalent voltages. Because the nearly complete curve is obtained so easily, however, such curves are valuable for comparing the performance of different x-ray tubes, and the operation of a given tube under different conditions. In general, the slope of the curve of the percentage of transmission becomes steeper for radiation produced by lower equivalent voltages.

The curves obtained are shown in Figure 7 along with those obtained by Lauritsen (2) and Coolidge (3). Their voltages were measured by direct methods. A comparison of the slopes of these curves after high filtration indicates that the equivalent voltage in our tube was 850 K V. This

cathode is shown clearly by the two experimental curves in this figure. After filtering through the first 10 mm of lead, the remainder of each curve has nearly the same slope and, therefore, indicates the same voltage. The higher position of the curve with the higher grid-bias indicates a much greater percentage of transmission of the initial intensity. In other words, the initial radiation contains a much smaller proportion of long wave length radiation when the bias is so high, and the operation approaches that of constant potential applied voltage.

The slope and position of the curves after filtration through 1 mm of lead show that while the difference in the percentage of transmission is small for the two different grid-bias voltages, the lower bias produces a lower equivalent voltage in addition to the slightly lower percentage of transmission. When the filtration of the lower biased curve is increased to 2.5 mm, in order to attain an equivalent voltage as great as that which the more strongly biased curve has after filtration through 1 mm of lead, the percentage of transmission is only one-half as great as that for the stronger bias. This effect is much more pronounced when greater variations in the bias are used.

The effect of varying the grid-bias voltage, with a constant applied voltage and a constant emission current, is that an increase in the bias increases the intensity as well as the quality of the radiation. Increasing the filtration can raise the equivalent voltage and thus the quality of the radiation, but it does so with considerable sacrifice of intensity. This apparatus thus demonstrates the futility of specifying the quality of radiation in terms of the peak voltage. Using the same applied or peak voltage and the same filtration, the quality as well as the quantity of radiation can be changed at will by varying the bias applied around the cathode filament.

Equivalent Voltage from the Curve of Absorption in Aluminum—The term "equivalent voltage" as applied to describing the quality of a composite beam of x-rays has been popularized by Lauritsen (4). He defined equivalent voltage as that required to produce radiation of equivalent wave length. "Equivalent wave length" is further described as that wave length of monochromatic radiation which has some pre-determined measurable property in common with the beam in question. A readily measurable property of any beam is its half value layer in different absorbers. In choosing the absorption material, certain properties are desired. Absorption by the collision of x-ray photons with electrons, called "Compton scattering" is described accurately by the Klein-Nishina formula. Aluminum, water, and the light elements have only this type of absorption for radiation in the range between 600 and 1,000 K V. Absorption by the heavier elements is complicated by varying amounts of photo-electric absorption in addition to Compton scattering. For this reason, copper and lead absorbers are not well suited to determining the equivalent voltage.

The correctness of the Klein-Nishina formula for the absorption in the light elements, such as aluminum, has been verified by Lauritsen. The formula may be depended upon, therefore, to give the

correct equivalent voltage for radiation absorbed by any of the light elements. On this basis, Lauritsen (4) has plotted a very useful curve using the half value layer in water, to determine the equivalent voltages of any beam of radiation after any initial filtration. Leucutia and Corrigan (5) have added a similar curve using aluminum.

The curves of absorption in aluminum after varying initial filtrations, using the same applied voltage and the same grid-bias, are shown in Figure 8. The half value layer is obtained from this curve at 1.7 ($i.e., \log_{10} 50 = 1.7$). By locating these half value layers on Lauritsen's calculated curves, the following equivalent voltages are shown:

1 mm lead	460 K.V
2 mm lead	620 K.V
3 mm lead	710 K.V

This increase in equivalent voltage with increase of initial filtration is represented graphically in Figure 9. The initial filtration in all cases is 0.5 mm of copper plus 3 mm of steel.

An estimate of the peak voltage can be obtained by using that thickness of lead which the curve of absorption in lead shows to produce an almost even slope, $i.e.$, more lead merely decreases the intensity without increasing the quality. Such a condition is present after about 1 cm of lead filtration. The half value layer in aluminum after such a filtration is 39 mm, which indicates an equivalent voltage of 850 K V, in this case nearly the peak voltage.

Constant Potential Equivalent—The Committee on Standardization of X-ray Measurements of the Radiological Society of North America has recommended the use of the curve of complete absorption in copper, together with a statement of the initial filtration as a satisfactory method for stating the quality of the x-radiation. They agree that the statement of the equivalent constant potential, applied to the tube terminals to yield the same curve, may be used as a single numerical designation (6). Taylor and Singer (7) recently published curves of absorption in

copper for constant potential voltages up to 550 K V. By "constant potential equivalent" they mean the constant po-

filters in addition (Fig 10). The initial filter used was 3 mm of steel plus 3.5 mm of copper.

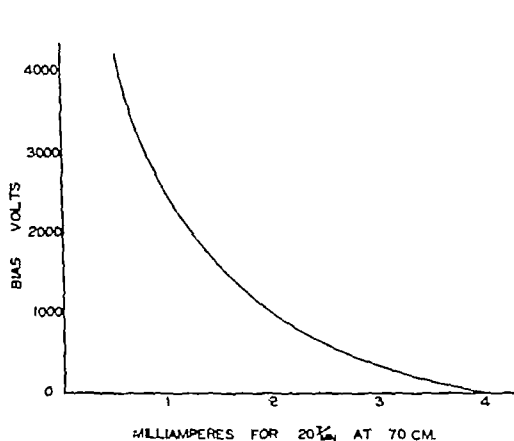


Fig 11 Curve showing the number of milliamperes required to produce 20 r per minute with decreasing bias voltages

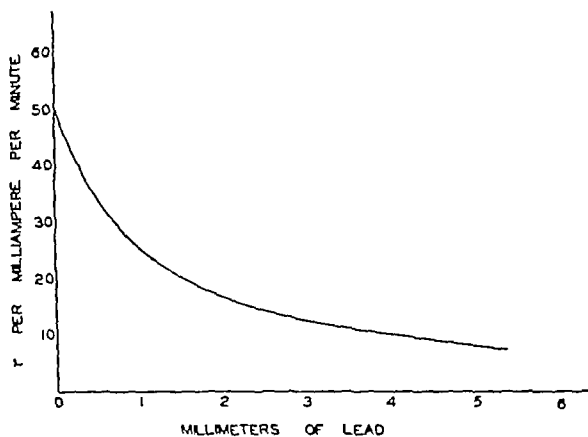


Fig 12 Curve showing the r output per milliampere minute with varying lead filters

tential necessary to apply to an x-ray tube to yield a "simple" absorption curve of the same form as the composite absorption curve in the same material for the unknown radiation in question.

While copper may be an adequate absorber for voltages up to about 200 K V, there are not sufficient data on the nature of the complex absorption in it for voltages above that level to permit the plotting of a useful curve or for obtaining the half value layer. Lead is a better heavy element for curves of complete absorption and aluminum is a better element for obtaining equivalent voltages, as has been shown above. The introduction of copper as an absorber for short wave length x-ray would seem to complicate the literature needlessly with data which could not be interpreted easily in terms of any other element. However, because roentgenologists are so accustomed to think in terms of the absorption in copper, and because Taylor and Singer have published standard curves made with constant potential currents up to 550 K V, a curve was obtained, using as nearly as possible the same initial filter as theirs, and other curves using lead

Effect of Grid-bias Voltage—Most, if not all, previous x-ray tubes have used the full high voltage of the tube on a shield of some type around the filament to focus the cathode stream. Few, if any, have used the principle, above described, of having a negative potential wall close to the filament so as to prevent the electrons from leaving the neighborhood of the filament until the higher ranges of potential difference between the cathode and anode are reached. By this means, only high speed electrons can reach the target, which is saved from bombardment and consequent production of heat by low speed electrons, and the resultant beam of x-rays contains a much higher proportion of the desired short wave rays.

The effect of varying the grid-bias on the r output per milliampere of emission current is well shown by the curve in Figure 11. The quantity output was kept constant at 20 r per minute at a distance of 70 cm from the target. The r output was measured by means of a parallel aluminum plate ionization chamber of the open air type and a high sensitivity galvanometer. The filter consisted of the

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THE DIAGNOSTIC AND THERAPEUTIC VALUE OF THE INTRATRACHEAL USE OF IODIZED OIL IN CASES OF INTRACTABLE ASTHMA

WITH SPECIAL REFERENCE TO ITS USE AS A CONTRAST MEDIUM AND THE PHYSICO-CHEMICAL MECHANISM ON WHICH ITS THERAPEUTIC VALUE IS BASED¹

By RAY M. BALYEAT, M.D., L. EVERETT SEYLER, M.D., and H. A. SHOEMAKER, PH.D., *Oklahoma City, Oklahoma*

THE treatment of all types of asthma by methods based on allergic findings has proved satisfactory in our hands in about 70 per cent of the cases, in the other 30 per cent, results have been only fair or poor. In a review of 1,240 asthmatic patients whom we have studied in our clinic during the past five years, we find that excellent or good results usually were obtained from those suffering from periodic attacks of asthma but who had periods during the year in which they were entirely free. On the other hand, fair or poor results were usually obtained in those patients who had periodic attacks of severe asthma but who also, daily between attacks, had either light attacks or raised considerable white glairy or semi-purulent mucus. Others working in the field of allergy have obtained somewhat similar results.

Anderson (1), in 1932, reported good results in several cases of a series of asthmatic patients to whom he had given iodized oil intratracheally as a therapeutic measure. In 1932, Ochsner (2), who treated a series of cases suffering from chronic bronchiectasis by the intratracheal use of iodized oil, reported results superior to other methods of treatment. In 1933, Cole (3) studied the intratracheal use of the oil in a series of pulmonary cases and was pleased with the results he obtained in patients suffering from bronchial asthma. The work of these three men first stimulated our interest in the subject. Last summer, one of us (R. M. B.) had the pleasure of observing the work of Forestier in his clinic at Aix-les-Bains, France. He has used the oil in the chest primarily for the purpose of a contrast

medium; it has never been used by the French as a therapeutic measure in asthma (4).

During the last fourteen months, we have treated 184 asthmatic patients of various types by using iodized oil intratracheally or transnasally in connection with specific allergic management. Many of these patients were cases which we had had under our care for from two to four years. In the patients suffering from periodic attacks of asthma with periods of absolute freedom, the combined treatment gave definitely better results than allergic management only. The results of the combined treatment in the intractable type, as compared with the usual method of treatment, were in many cases very striking and have encouraged us to make a report on the use of iodized oil in conjunction with specific desensitization in 50 cases of intractable asthma, most of which we have had under our care for from six months to four years.

Dual Etiology of Intractable Asthma—Why many asthmatic patients have periodic attacks of asthma throughout life but are entirely free from symptoms between attacks, while others, either early in life or during middle or old age, suffer continuously from mild to severe attacks or at least cough and raise purulent mucus between attacks, is a question that has never been satisfactorily answered. As a possible explanation, let us consider the following history that is so commonly given by the chronic asthmatic patient.

In childhood a patient suffered from hives and eczema and had frequent bronchial colds with which he would occasionally wheeze. During the teens he was moderately free from his skin and bronchial trouble. In the twenties he developed

¹ From the Balyeat Hay Fever and Asthma Clinic, and the Department of Pharmacology, University of Oklahoma Medical School, Oklahoma City, Oklahoma.

following, in the order given 0.5 cm Cu, 3 mm steel, 1 mm Pb, 1 mm Cu. The following readings are typical

4 ma	no bias
2 ma	1 000 volt bias
1 ma	2 500 volt bias

Effect of Filters and Grid-bias on the r Output—The quantity output of radiation as measured in r units per milliamperem-minute is an important consideration in any apparatus. Hence the curve shown in Figure 12 is reproduced to show this factor for the apparatus under discussion.

In treating patients, a constant output of 20 r per minute has been used and thus curves are not given for excessively high outputs which could be used if desired.

SUMMARY

1 An apparatus is described which uses a radio frequency circuit to provide high voltages for the production of x-rays to be used therapeutically.

2 The apparatus is shown to be rugged, compact, and economical in construction and operation.

3 The curves of absorption in lead show a peak voltage of at least 850 K V. The application of grid-bias voltages to a shield around the cathode filament results in operating characteristics simulating those of constant potential apparatus.

4 The "equivalent voltage" as determined by the curve of absorption in aluminum is shown to be high in proportion to the applied voltage. With an applied voltage of about 850 K V, an equivalent voltage of 620 K V is attained with 2 mm of lead, and 710 K V with 3 mm of lead as a filter.

5 The "constant potential equivalent" is high, but this method of measurement of high voltages is not recommended.

6 The great advantage of a grid-bias voltage applied around the cathode filament is demonstrated by showing the reduced amount of emission current needed to get the same r output and a better quality of beam.

7 The r output per milliamperem-minute is shown to be satisfactory.

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tween three and four, and others between five and six. A satisfactory explanation of why some patients have their symptoms

Diagnostic Points Differentiating Asthmatic Bronchiectasis from the Usual Form of Bronchiectasis—In the study of the chronic



Fig 3 (left) Asthmatic bronchiectasis (saccular form) Note the multiple pus pockets their size location and their connection with small bronchioles Postural drainage in this case was not productive, but brought on severe attacks of asthma

Fig 4 (right) Asthmatic bronchiectasis (tubular form) Note location and the fact that many of the bronchial branches are larger than the stem

early in the night and others later has never been given. When one considers the mechanics of the bronchial tubes, the following explanation seems plausible. In one individual the amount of mucus produced is fairly great, and, therefore, it requires only from two to three hours after retiring for enough mucopurulent material to collect in the bronchioles or in the bronchiectatic sacs to demand a "cleaning-out process," which is an asthmatic attack. In another individual it takes from four to five hours, and in another, six to seven hours for a sufficient amount of mucopurulent material to collect to require the mechanical procedure to take place. For this reason, in one case the attacks should occur each night about two o'clock, in another at three to four o'clock, and in the third at five or six o'clock in the morning.

In determining etiologic factors and planning therapeutic measures in intractable asthma, we believe that careful consideration should be given not only to the specific sensitization findings, but also to the local pathology of the bronchial tree produced by repeated superimposed infections on the hypersensitive bronchial mucosa.

asthmatic, we have found many who raise enormous quantities of purulent sputum, which usually does not occur at one time but is distributed throughout the day. The sputum ordinarily does not have an offensive odor. Iodized oil bronchograms in the usual type of bronchiectasis will show the bronchiectatic area or areas connected with a fair sized bronchus or bronchi, while in asthmatic bronchiectasis the bronchiectatic sacs are usually small and located at the end of bronchioles. They are usually multiple and are often located in one section of the bronchial tree, but they may be scattered throughout a large area. Many cases show a combination of the saccular and tubular forms.

Is Postural Drainage of Value in Asthmatic Bronchiectasis?—Since the sacs of the usual form of bronchiectasis are connected with a fair sized bronchus or bronchi, postural drainage should be and is of value in relieving the patient of purulent sputum. On the other hand, since in asthmatic bronchiectasis of the saccular type the pockets are usually connected with small bronchioles, or the dilated branches in the case of the tubular type are larger than the stem,

midsummer and fall hay fever but no asthma. After ten or fifteen years of seasonal hay fever, an acute cold was encoun-

appeared for a couple of decades. Later, however, he became sensitive to midsummer and fall pollens which produced hay



Fig 1 Usual form of bronchiectasis. Note the large, irregular tubular areas and their location and connection with moderate sized bronchi. Postural drainage in this case is of value.



Fig 2 Usual form of bronchiectasis. Note the sacculo-tubular area connected with a fair sized bronchus. Postural drainage was of value.

tered at the end of the season and the patient suffered with asthma for a few days. The next fall, asthma developed and persisted for two or three weeks. The fall following this, the siege lasted for six weeks. From that time on during the following year, with each cold, asthma occurred. A year or two later the attacks became much closer together, and he found that daily he either suffered from an attack of asthma or raised considerable sputum which was usually semi-purulent in type.

A study of the asthmatic over a period of years has led us to believe that what actually happened in such a case is as follows: in early life the patient became sensitive to food and to the animal epithelial group. The foods to which he was sensitive caused his eczema and hives. The food sensitization plus a sensitization to inhalants were the exciting factors in his bronchial colds. As he grew older, he automatically became desensitized to many of the foods and, therefore, lost his dermatologic symptoms. In the late teens and early twenties he naturally came in contact with less house dust, and, therefore, his asthmatic symptoms dis-

appeared for a couple of decades. Later, after hay fever had existed for years, the repeated bronchial infections from which he suffered each fall produced not only plugging of the bronchioles, but finally asthmatic bronchiectatic areas, therefore, asthma occurred at any time during the year. In the so-called intractable cases of asthma, a history somewhat similar to the one just given is usually obtained.

It appears, therefore, that patients suffering from intractable asthma may have asthma from one of two of the following sources or from a combination of both: first, the attack may be caused by edema of the bronchial tubes, due to contact with or ingestion of the substances to which they are specifically sensitive (the congestion is similar to the edema of the nasal mucosa of a hay fever patient); second, the asthmatic symptoms may be caused by mechanical plugging of the bronchioles and filling of the bronchiectatic areas, or the attack may be due to a combination of the two.

In cases of the intractable type, some patients develop attacks of asthma each night between one and two o'clock, others be-



Fig 6 Position of patient for filling lower section of right bronchial tree



Fig 7 Position of patient for filling lower portion of the left bronchial tree

complicated, it is not practical as a routine procedure for giving iodized oil for bronchographic purposes or as a therapeutic measure under unusual conditions it might be indicated. The transnasal method, one used rather extensively by Forestier at the present time, we have found to be fairly satisfactory in patients who seem to take the oil with difficulty by the intratracheal method, however, these patients are rare. The latter of the three methods, namely, the intratracheal, is the one of choice as a routine procedure.

The exact method of giving the oil intratracheally varies greatly in the hands of different operators. The method we are now using is a combination of Cole's (3), Singer's (7), and Ochsner's (2). It has previously been described by us (5). However, during the last six months we have considerably modified the method which we previously described. In brief, our present method of giving oil intratracheally is as follows:

Preparation of the Patient—The bronchial tree of the intractable case of asthma usually is accustomed to considerable irritation, therefore, the introduction of a small amount of a non-irritating oil usually is not disturbing to the patient. When the oil is to be given, either for the purpose of a bronchogram or as a therapeutic measure, if the patient is wheezing or coughing he

should have from 6 to 10 minims of adrenalin a few minutes prior to its introduction. The adrenalin decreases the amount of edema of the bronchial tubes and also allows the patient to bring up a considerable amount of mucus, thereby permitting the oil to better penetrate the bronchioles and the bronchiectatic areas. If the asthmatic also suffers from the usual form of bronchiectasis, postural drainage should first be given.

The patient is advised to come for his oil without breakfast, just before the noon lunch, or prior to the evening meal, as the gag reflex and tendency to nausea are less at these periods.

Just prior to giving the oil the first time, especially if a bronchogram is to be made, which always should be done in the chronic asthmatic, the throat of the patient should be sprayed with a 2 to 4 per cent solution of cocaine hydrochloride while he breathes deeply, so as to allow the spray to reach the bifurcation of the trachea. The cocaine reaching this area will help to overcome the cough reflex. After taking the oil for the first time, the patient realizes there is no pain connected with the procedure, very little discomfort, and that the cocaine is bitter, and from that time on the oil usually can be given without local anesthesia and without any difficulty.

Preparation of the Oil—We have learned

it would be almost impossible for the thick purulent mucus to drain through the small tubes when postural drainage is attempted

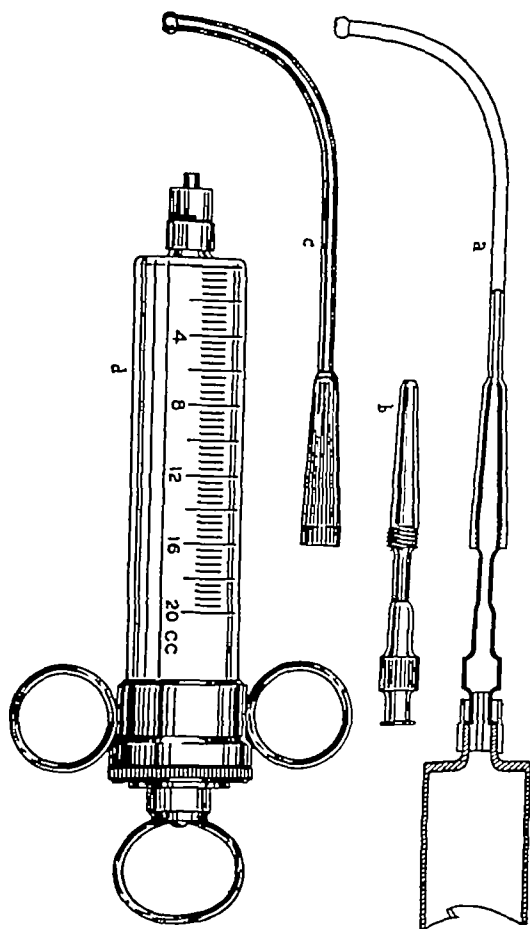


Fig 5 Convenient syringe and laryngeal cannula for giving iodized oil

We mention the difference in the mechanics of the two types of bronchiectasis because so many of our patients with bronchial asthma of the chronic type have often been advised to try postural drainage. Invariably the results are non-productive of sputum, but the procedure brings on a severe attack of coughing or asthma. We believe that in asthmatic bronchiectasis of either the tubular or the saccular type, postural drainage is not only not indicated but contra-indicated.

Iodized Oil Preparations Used in Diagnosis and Treatment—In the first half of our study, we used two iodized oil preparations,

namely, lipiodol, which is said to contain 40 per cent of iodine and no chlorine, the specific gravity of which is 1.37–1.45, and lipoiodine, which is said to be ethyl duodecyl sebacate dissolved in sesame oil, the specific gravity of which is 1.097. We found both of these oils satisfactory in the treatment of many cases, but the heavier oil was much more satisfactory for bronchograms and also for therapeutic purposes in cases of asthmatic bronchiectasis. The lighter oil was more easily given and more easily taken by the patient. Apparently it was more easily tolerated by an asthmatic patient of any type during an acute infectious process. We found the lighter oil very satisfactory in the asthmatic without bronchiectasis but whose continuous asthma was due to plugged bronchioles. The details of the two oils have been discussed in a previous paper (5).

During the last eight months, we have used almost exclusively the lighter oil, namely, lipoiodine, and one we have prepared in our own laboratory, by incorporating iodine in poppy-seed oil by the iodine chloride method. The iodine content of this oil is approximately 27 per cent, and the chlorine content 8 per cent. The specific gravity varies from 1.226 to 1.30. An ideal iodized oil to be used for bronchograms and also for therapeutic purposes in asthma should be one with moderate viscosity so as to be easily given, with fairly high specific gravity so it will not be easily coughed up, and with an iodine content sufficiently high so it will serve as a good contrast medium for delineating the bronchial tree, and, chemically, it should be a fairly stable oil. These properties we have found in the oil which we are using that contains iodine and chlorine.

Technic of Giving Iodized Oil—There are three methods of injecting iodized oil into the bronchial tubes, namely, transtracheal, transnasal, and intratracheal. The first and third methods were described originally in detail by Sicard and Forestier (6), and more recently Forestier (4) has described the second method. Due to the fact that the transtracheal method is quite

trachea instead of flowing down the wall, it produces more irritation and frequently starts coughing

a week for two to four weeks and then changed to a seven- or ten-day interval and continued for months. As a therapeutic

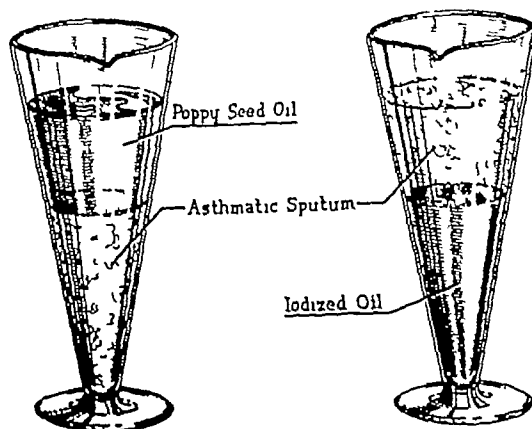


Fig 10 Experiment *in vitro*, demonstrating what would happen if plain poppy seed oil were used in the bronchial tubes, also what actually happens when iodized oil is used

Amount of Oil Used for Bronchograms and Therapeutic Purposes—For the purpose of a bronchogram, from 15 to 20 c c should be given on both sides, for treatment purposes, from 5 to 10 c c. After the oil is given, the patient should remain quiet, without coughing if possible, for five or ten minutes before the bronchogram is made. Likewise, for therapeutic purposes the patient should withhold coughing for a few minutes so as to allow the oil to penetrate the mucus-plugged tubes. Plugged bronchioles and bronchiectatic areas are practically always found in the lower portion of the bronchial tree, therefore, it is only this area that needs to be injected.

If the bronchogram shows no saccular bronchiectatic areas but only plugging or moderate dilatation of the bronchioles, the oil is given twice a week for a period of two or three weeks, using from 7 to 10 c c on each side at the same sitting. It is then given once a week for two to four weeks, depending on the amount of relief the patient obtains. From that time on, the oil is given at an interval of three to five weeks. If there is evidence of moderate to marked asthmatic bronchiectasis, especially if it be of the saccular type, the oil is started twice

measure, in cases with evidence of bronchiectatic areas, we have found the heavier oil much superior to the lighter.

Results of Treatment—Of the 50 cases, all of the so-called intractable type, in which we have given iodized oil intratracheally for therapeutic purposes, 36 had been under allergic management from six months to four years, with unsatisfactory results. In all of the 36 cases, the routine treatment was not changed except that the intratracheal use of iodized oil was added, using the interval we have described. The other 14 cases, which had been under our care less than six months or were new, were all allergic, complicated with asthmatic bronchiectasis of either the tubular or saccular type. They were treated also by combining allergic management with the use of the oil, as oil in itself could not cure a patient suffering from allergic asthma.

In some of our cases, the oil has been given over a period of fourteen months. To one patient, oil has been given 45 times; the total number of times it was given to the 50 cases was 701. We observed that usually after four to six doses had been given, patients were definitely better, and occasionally improvement occurred after

that if the oil is warmed to about 110° F it is very satisfactory, both for bronchographic and therapeutic purposes. At this

and he should remain in that position from five to ten minutes. The more nearly horizontal position is required on the left side be



Fig 8 Note the angle the left bronchus makes with the trachea



Fig 9 Diagrammatic sketch. Note position of the point of the laryngeal cannula

temperature the viscosity is such that the oil penetrates the plugged bronchioles well and enters the bronchiectatic areas, if they be present, and yet sufficient quantity will stick to the walls of the bronchial tubes to delineate them well.

Instrument for Giving Iodized Oil—An instrument for giving the oil is shown in Figure 5. A 20 c c Luer-Lok Control syringe is used. This is ideal providing one is treating a large number of patients, if only a few patients are cared for, a 10 c c B-D Luer-Lok Control syringe is just as satisfactory. The laryngeal cannula we use is divided into two parts. With part *b* (Fig 5) attached, the warm oil is drawn through into the syringe. The soft-metal laryngeal cannula tip *c* is attached as shown in *a*. The cannula as shown in Figure 5 we have found to be very convenient, but the regular B-D soft-metal laryngeal cannula is quite satisfactory.

Position of Patient—To fill the right side, the patient should be comfortably seated at a table so that he can lean to the right (Fig 6). In filling the left side, to obtain the best results the patient should recline on the left elbow on a lounge (Fig 7),

cause the left bronchus is often at almost a right-angle with the trachea (Fig 8). In filling either side, the patient's head should be maintained as nearly vertical as comfort will permit. The tongue, protected by a gauze or paper napkin, is grasped and pulled well forward in order to aid in preventing the patient from swallowing.

If the patient uses very rapid, shallow breathing, the lungs will be comfortably aerated and the epiglottis will remain open. Deep breathing is not advisable, as it would start coughing.

The tip of the cannula (Fig 9) is first placed just back of the tongue in the center line and then pulled forward so it just barely touches the root of the tongue. The barrel of the cannula should rest on the operator's thumb which is holding the tongue, a procedure which serves two purposes, namely (1) It gives stability to the instrument, (2) if the nurse has heated the oil too high, it will be easily detected by the operator as the oil flows through the metallic cannula. The oil is given by rapid drops or in a constant stream and allowed to flow down the back of the tongue into the trachea. If allowed to drop into the

it was not an early procedure, because after four hours no iodine could be found in the urine of the dogs

Our experimental work with dogs naturally leads us to believe that, when iodized oil is injected into the bronchial tree of the



Fig 11 Bronchogram of a patient to whom iodized oil had been given once. Note the many small mucus plugs.



Fig 12 Bronchogram of a patient to whom oil had been given several times. The bronchial tubes and bronchioles are well filled.

Sicard and Forestier (6) have recorded in their book, "The Use of Lipiodol in Diagnosis and Treatment," a table showing the rapid elimination of iodine through the bronchial wall in the human. In talking with Forestier, we called his attention to our experimental work on dogs, which indicated that iodine was not absorbed through the bronchial wall during the first three or four hours, and he suggested the possibility that the iodine-freeing process took place only after several hours of contact with the bronchial mucosa.

As a means of determining what happens to iodized oil retained in the bronchial tubes from three to five days, we (10) gave repeated intratracheal injections of iodized oil (lipiodol—same as used by Forestier) to a series of dogs, to another group the oil was given through an intubation tube so no oil could be brought back into the mouth and swallowed. In brief, the results were as follows: the dog of the first group excreted, by the kidney, 236 mgs of iodine on the second day, while the dog of the second group showed an output in the urine of 15 mgs of iodine, having excreted the largest amount of iodine in any one twenty-four-hour periods.

asthmatic patient, a small amount breaks down in the bronchial tubes, either by the process of oxidation or by a fat-splitting enzyme, but that most of the oil is brought up into the mouth, swallowed, saponified in the jejunum, and absorbed into the lacteals before iodine is liberated.

Ochsner (2 and 9) believes that the beneficial effect of the intratracheal use of iodized oil in bronchiectasis and also in chronic asthma is partially due to its bactericidal effect. It appears to us that if there is a bactericidal effect, it would have to be due to one of the two following sources: (1) the presence of the oily substance itself, or (2) to free iodine. To determine the possible effect of the first factor, we added iodized oil to tubes of asthmatic sputa and incubated them 48 hours. The bacterial growth in these tubes was no less than the controls. It is true that Ochsner (2) found the bacterial count of the sputa from the bronchiectatic patients to whom he gave repeated intratracheal injections of iodized oil to decrease. This can be explained by the fact that the heavy oil is constantly replacing the purulent material. The new bronchial secretions formed in the large bronchial tubes naturally are

the first or second dose. We have learned that in those patients whose bronchograms showed evidence of plugging of the bronchial tubes only, practical relief from symptoms was obtained after the oil had been given only a few times. Good results were not accomplished so quickly in patients whose bronchograms revealed evidence of asthmatic bronchiectasis, and usually the greater the amount of bronchiectasis, the slower was the progress. In nearly all patients in whom poor results were obtained, bronchograms revealed evidence of marked bronchiectasis.

We have classified the results of 50 cases of intractable asthma, treated by combining the use of iodized oil intratracheally with allergic management, as follows:

Very good	7, or 14 per cent
Good	28, or 56 per cent
Fair	6, or 12 per cent
Some relief (25 per cent)	4, or 8 per cent
Poor	5, or 10 per cent

To one who has dealt with chronic cases of asthma for fourteen years and therefore knows, in the main, how unsatisfactory treatment of cases of intractable asthma based solely on allergic findings has been, the therapeutic effect of the oil is a welcome measure, but more so has it been welcomed by the chronic sufferer.

Certainly the oil is in no way curative, but only a mechanical means of freeing the pendent bronchial tubes from the plugged mucus and the bronchiectatic areas from purulent sputum, thereby not only giving the patient freedom from asthmatic spasms, but relieving him from the absorption of toxins. In many cases, we have observed patients who were temperature-free but who ran white blood cell counts from 14,000 to 18,000, which would become nearly normal or normal after the oil had been given a number of times. These patients would regain their lost appetite, their haggard appearance, doughy skin, and relaxed muscles would soon change to that of the average normal.

Contra-indications—Ochsner (2), Cole (3), and Amberson (8) have suggested certain contra-indications, and, without ques-

tion, there are contra-indications, as we have pointed out in a previous study (5). However, it would be very unusual to find a case of chronic asthma of the type we are reporting in which the use of a non-irritating, non-absorbable oil such as iodized oil would be contra-indicated. A patient whose bronchial tubes have been infected for years and who has continually raised mucus or purulent material should theoretically tolerate such an oil with ease. However, it must always be remembered that a patient who has an idiosyncrasy to iodides will not tolerate the oil, because a small amount is broken down in the bronchial tubes, the iodine absorbed through the bronchial wall as iodides, and the remainder finally is brought up into the mouth little by little, swallowed, saponified in the jejunum, absorbed into the lacteals, lipodieresis occurs, and the iodine is liberated by the lungs and kidneys as iodides. Most of these patients, however, have taken iodides from time to time, and, therefore, a history will determine their ability to handle the oil. There are other contra-indications, as we have previously mentioned, but it would be unusual to find them in a chronic asthmatic.

Physico-chemical Mechanism—After observing the therapeutic value of iodized oil as an agent for temporary relief in patients suffering from asthma of the intractable type, we became very much interested in its physico-chemical mechanism. The fact that we (5) could find iodine in the urine of a patient from thirty to forty minutes after the oil had been given intratracheally, and in large amounts from two to five hours later, made us feel, as did For-estier (4), that in the bronchial tubes, in some way, a fat-splitting process had taken place. It occurred to us that the iodides passed through the bronchial wall, and, by so doing, changed the polarity of the goblet cell of the bronchial mucosa, thereby checking the formation of the white glairy mucus. Experimental work, which we did by injecting the oil into the bronchial tubes of dogs, led us to believe that if a fat-splitting process took place in the bronchial tubes,

it was not an early procedure, because after four hours no iodine could be found in the urine of the dogs

Our experimental work with dogs naturally leads us to believe that, when iodized oil is injected into the bronchial tree of the



Fig 11 Bronchogram of a patient to whom iodized oil had been given once. Note the many small mucus plugs



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much less purulent than the material in the bronchiectatic areas. In considering the second factor, we must not forget the state-

chanical. In explaining the mechanical therapeutic effect of the oil, one must take into consideration its physical properties

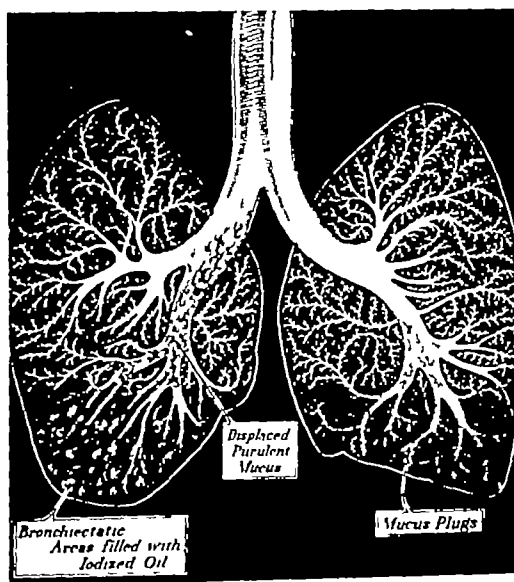


Fig 13 Diagrammatic sketch demonstrating mechanical effect of iodized oil. Note replaced mucus.

ment of Sollmann (11) "Free iodine cannot be liberated in the body, since all conceivable reactions for the liberation of iodine from its compounds require much higher hydrogen ion concentration than exists anywhere in the body." The only exception he makes is in case of gastric juices in which the acidity may be sufficient to liberate iodine. Iodine that is apparently liberated in the bronchial tubes instantaneously becomes sodium or potassium iodide. It appears that the second factor, namely, free iodine, as a bactericidal agent must be forgotten. It is possible that the small amount of iodine that is liberated, which becomes sodium or potassium iodide, may help in liquefying the tenacious mucus in the bronchioles, just as it does when iodides are administered by mouth.

After giving the oil in our clinic 3,240 times and watching its effect on various types of asthma, including the intractable type, and after reviewing very carefully our experimental work, we believe that the therapeutic value of the oil is primarily me-

Note the specific gravity of the following products

Asthmatic sputum	Sp gr 1.012
Plain poppy seed oil	Sp gr 0.910
Sesame oil	Sp gr 0.916
Lipiodine	Sp gr 1.097
Iodized oil prepared in our own laboratory, 35 per cent	Sp gr 1.226-1.300
Lipiodol 40 per cent	Sp gr 1.37-1.45

The 35 per cent iodized oil which we are using almost exclusively at the present time is made by iodizing the poppy-seed oil with iodine chloride. It is obvious, therefore, that the oil contains both iodine and chlorine. Prepared by this method, the oil is slightly viscous, pale amber, and is a neutral liquid with an oleaginous taste (resembling "cooked" oil) and has a specific gravity of 1.228 at 25° C. It contains no free iodine. After it stands for several weeks in the dark, there is no color change, and neither is there free acid nor free iodine. Some darkening is observed when the product is exposed for the same length of time to light, but repeated tests will not show the presence of free iodine or free chlorine.

It is important to point out that the presence of chlorine makes the oil in no way objectionable, clinically. On the other hand, we have evidence to indicate that its presence actually lends increased stability. Its gravity is sufficiently greater than asthmatic sputum to be an excellent replacement medium. It contains sufficient iodine to make it a good contrast medium.

After giving the oil the first time to a patient with plugged bronchioles, one will observe many plugs persisting (Fig 11), while after giving it several times the bronchogram will appear (Fig 12). During or just following the giving of the oil to one with asthmatic bronchiectatic areas, the patient will frequently cough, but instead of raising oil, purulent asthmatic sputum will be brought up. Consider what would happen to the plugged bronchial tubes and bronchiectatic areas when iodized oil is given (Fig 13).

We feel, after careful experimental work with animals and a clinical study of the intratracheal use of iodized oil in patients with intractable asthma, that its efficacy lies (1) in the mechanical coating over of the bronchial mucosa of the pendent tubes, preventing contact with the allergenic substances, (2) by lubricating the bronchial tubes, thereby preventing plugging, (3) by replacing the purulent material in the bronchiectatic areas so as to prevent the absorption of toxins, and (4) after the oil is brought up, swallowed, saponified, absorbed, and lipoidieresis takes place, it is partially eliminated by the bronchial tubes, giving an effect similar to the use of iodides by mouth. Therefore, it appears that the therapeutic value of iodized oil given intratracheally is both chemical and mechanical, but its primary value lies in its replacing and lubricating action.

CONCLUSIONS

1 Most cases of intractable asthma have a dual etiology, namely, a specific sensitization factor and also a mechanical condition produced by tenacious mucus or purulent material, either of which can produce asthmatic attacks.

2 Asthmatic bronchiectasis, which commonly occurs in intractable asthma, clinically and mechanically differs from the usual form of bronchiectasis. Postural drainage is not indicated in asthmatic bronchiectasis.

3 In the treatment of intractable asthma, we believe that consideration should be given not only to the specific sensitization findings, but also to the mechanical condition of the bronchial tubes due to the local pathology of the bronchial tree which, in turn, is produced by repeated superimposed infections on the hypersensitive bronchial mucosa.

4 An ideal medium for the treatment of the mechanical factor in intractable asthma is an iodized oil. An ideal iodized oil should have the following properties: non-irritating, non-absorbable, moderate viscosity, a sufficient gravity (1.225–1.40) so the oil is not easily coughed up and an iodine content sufficiently high to make it a good contrast medium for bronchographic purposes.

5 The intratracheal method of administering the oil is the one of choice, both for diagnostic and therapeutic purposes.

6 Usually, only the lower section of the bronchial tree need be injected when the oil is used as a therapeutic measure in asthma. The filling of the left lower section is somewhat difficult, the correct position of the patient is important.

7 For bronchograms, 15 to 20 c.c. of iodized oil should be put on each side. For therapeutic purposes, from 5 to 10 c.c. should be given at weekly, biweekly, or monthly intervals.

8 Of the 50 cases of intractable asthma in which poor results had been obtained by allergic management, very good or good results were obtained in 70 per cent by combining the use of iodized oil intratracheally with allergic management.

9 In the treatment of chronic asthmatics, contra-indications are not many, the intolerance to iodides is the one most commonly encountered.

10 The therapeutic value of iodized oil given intratracheally to the intractable

asthmatic appears to be due primarily to the mechanical effect of the oil

11 The heavier iodized oils are excellent contrast media for delineation of the bronchial tree

12 The intratracheal use of iodized oil cannot, in itself, cure a patient suffering from allergic asthma, but it is of inestimable value as a means of forcing up bronchial plugs and replacing pockets of pus with a non-irritating, non-toxic substance

13 In the treatment of intractable asthma, eliminative measures and desensitization against the substances to which the patient is specifically sensitive, are of first importance. From our present study, we are led to believe that the intratracheal use of iodized oil in the bronchial tubes is next in importance. A combination of the specific and the mechanical is ideal treatment in cases of intractable asthma

14 After using iodized oil in the treatment of asthma of various types over a period of fourteen months, we feel that it is an indispensable measure in the treatment of cases of intractable asthma

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SIMULTANEOUS MULTIPLE FIELD IRRADIATION WITH A 45-GRAM RADIUM PACK¹

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Burton T Simpson, M D , Director

IN 1930 a radium pack was designed and constructed as described in two previous papers (1, 2) to contain four grams of radium. The radium was distributed in 100-milligram tubes over an area 8×8 cm, each radium tube

treating large lesions located at or near the surface. When treating deep-seated lesions, however, such as those of the mid-pelvic region, this wide spreading of the beam prevents a close spacing of adjacent fields, particularly when multiple ports of

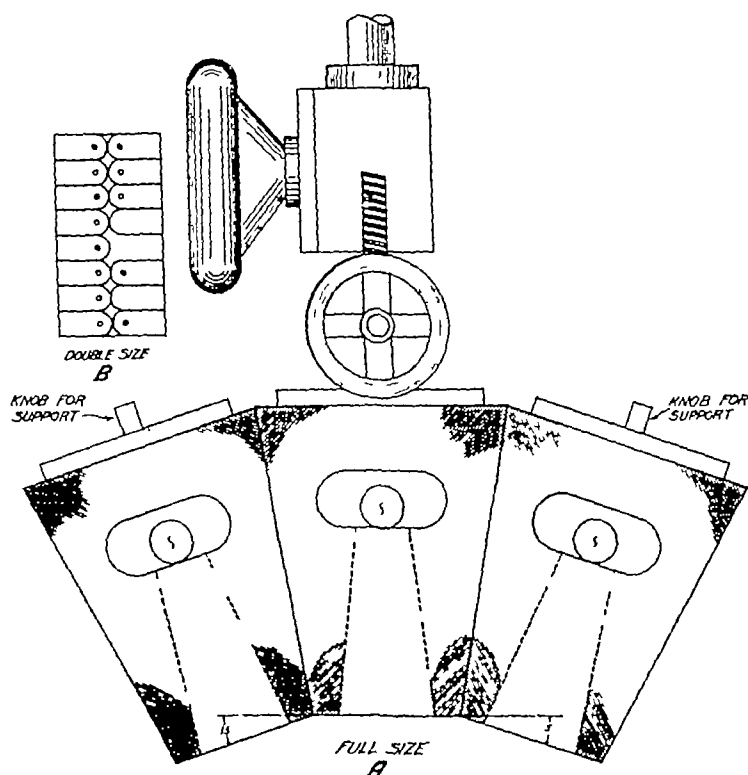


Fig 1-A Assembly drawing of the three-section pack showing relation of various parts

Fig 1-B Arrangement of the 100 mg tubes in the tray

radiating the entire field of 10×10 cm, at either 6, 10, or 15 cm radium-skin distance. The large radiating area and field size results in extreme spreading of the beam after it leaves the pack, especially at the shorter distances. This characteristic is a decided advantage when

entry are used to produce a cross-firing effect at depth. It was found that with this pack at a radium-skin distance of 10 centimeters, two anterior and two posterior ports could be used to advantage, provided a distance of 5 centimeters was maintained between the ports on each skin surface, and that the angle did not exceed 15° .

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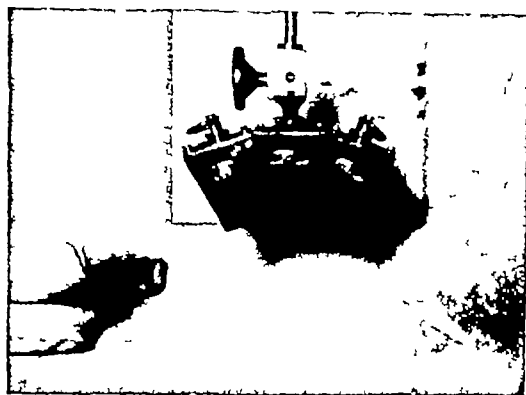


Fig 2 View of the three section pack showing angulation (15°) of the individual sections. This angle may be increased by inserting wedges between the sections.

This arrangement produced a depth intensity of 63 per cent at the midpoint of a pelvis 20 centimeters antero posterior dimension. Because of the field size and the space required between adjacent fields, it was impossible to apply more than two fields with this pack to either the anterior or the posterior surfaces of such a pelvis. Two lateral fields could, of course, be used in addition to the two anterior and posterior fields, but the distance from these

lateral fields to the interior was too great to cause a sufficient increase to warrant their use, moreover, the skin areas on those surfaces adjacent to the treatment area would receive considerable radiation from the lateral port, due again to the extreme flare of the beam. Actual estimation by means of isodose charts, of the intensity at depth with two anterior, two posterior, and two lateral ports, showed that the intensity at the 10 cm depth had increased to only 66 per cent, with all skin areas receiving 100 per cent at a radium skin distance of 10 centimeters. Greater intensities than these were desired, in order to effectively radiate the deep seated lesions. Of course, a greater intensity could be obtained for mid-pelvic regions, by using the pack at a distance of 15 centimeters, but the treatment time would be lengthened to such an extent, especially with multiple ports, that this method was found to be impractical with the amount of radium available. Furthermore, at this distance, more radiation penetrates to the opposite skin surface, which necessarily reduces the dose which can be applied to

CHART I

Ra-S D	New Pack		Four-gram Pack		
	1 Section	3 Sections	6 cm	10 cm	15 cm
	10 cm	10 cm		10 cm	
	63 r/gm hr	69 r/gm hr	86 r/gm hr	50 r/gm hr	28.5 r/gm hr
Surface Int					
Depth	%	%	%	%	%
0 cm	100.0	100.0	100.0	100.0	100.0
1	88.8	91.0	87.5	91.0	91.0
2	76.5	80.0	71.5	76.0	80.5
3	65.3	72.5	59.1	65.1	71.0
4	55.0	67.6	49.3	56.1	62.0
5	46.6	64.0	41.3	49.0	54.0
6	40.0	60.8	34.7	42.4	47.5
7	33.3	58.0	29.1	36.7	42.0
8	29.5	55.0	24.6	31.8	36.7
9	25.6	51.6	21.3	27.5	32.3
10	22.2	48.0	18.7	24.0	28.5
11	19.9	43.8	16.6	21.3	25.7
12	16.7	39.3	14.9	19.0	23.5
13	13.3	35.0	13.3	17.3	21.2
14	12.2	31.2	12.0	15.6	19.3
15	10.5	27.8	10.8	14.2	17.5
16	8.6	25.0	9.8	13.0	16.2
17	7.1	22.2	8.9	11.8	14.8
18	5.9	20.1	8.0	10.8	13.5
19	4.8	18.5	7.3	10.0	12.3
20	3.8	17.0	6.7	9.1	11.5

The surface intensities as listed include tissue scattering

that skin surface and, therefore, reduces the dose in the mid-pelvic region

In order to produce a greater intensity

are parallel to one another and there is a space of 3 centimeters between adjacent fields Each section is inclined 15 degrees

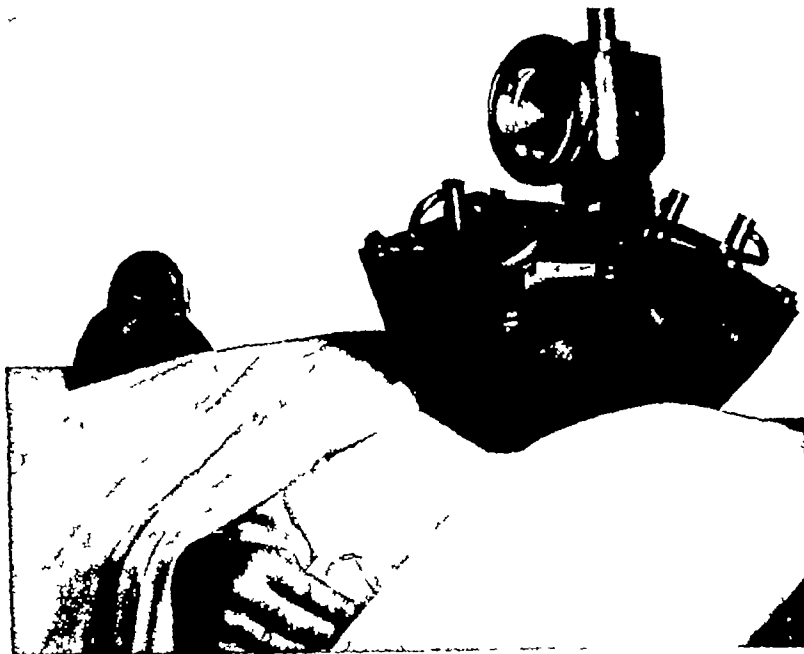


Fig 3 Three-section pack applied to a patient

at depth by the utilization of more ports of entry, it was decided to remove the radium from the 4-gram pack, and redistribute it in a pack of radically different design and purpose

This new pack (Figs 1, 2, and 3) is essentially a three-cannon arrangement, or three separate packs arranged in a manner not unlike that of Mallett and Danne Each cannon, or section, is a unit in itself, and may be used singly or in any combination The radium is contained in three removable trays, in each of which there is 1.5 grams of radium, making a total of 4.5 grams in the pack as a whole The radium tubes were arranged in each tray to occupy as small a space as possible (Fig 1-B) The radiation from each tube was spread over a rectangular area 5.4×9.3 centimeters This arrangement in each cannon, unlike the 4-gram pack, reduces the extreme flare of the beam (Fig 4) and permits a closer spacing of the fields The long axes of the three fields

from the neighboring section For most work, when the three sections are used as a unit, the long axes would be applied parallel to the long axis of the body The radium-skin distance of this pack is 10 centimeters At this distance with the smaller field size, the careful arrangement of the individual radium tubes observed in constructing the 4-gram pack, is not essential

In a previous paper (3) it was pointed out that when the radium tubes are in a perpendicular position as they were in the former 4-gram pack, the intensity may be reduced as much as 20 per cent, due to the fact that the lower layers of radium act as a filter and remove some of the gamma rays In the new pack, this so-called "intrinsic filtration" was avoided to a large extent by placing the tubes in a horizontal position Subsequent measurements showed a gain of 26 per cent, over the former 4-gram pack, due in part to the close arrangement of the radium tubes

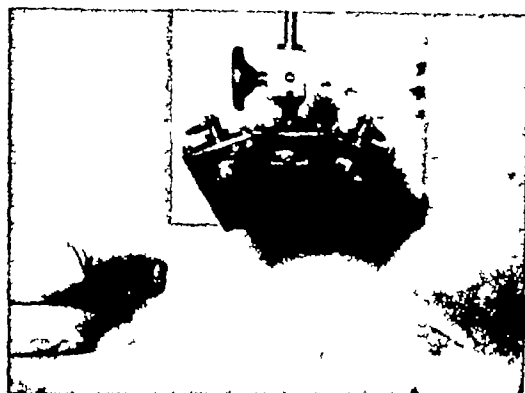


Fig 2 View of the three section pack showing angulation (15°) of the individual sections. This angle may be increased by inserting wedges between the sections.

This arrangement produced a depth intensity of 63 per cent at the midpoint of a pelvis 20 centimeters antero posterior dimension. Because of the field size and the space required between adjacent fields, it was impossible to apply more than two fields with this pack to either the anterior or the posterior surfaces of such a pelvis. Two lateral fields could, of course, be used in addition to the two anterior and posterior fields, but the distance from these

lateral fields to the interior was too great to cause a sufficient increase to warrant their use, moreover, the skin areas on those surfaces adjacent to the treatment area would receive considerable radiation from the lateral port, due again to the extreme flare of the beam. Actual estimation by means of isodose charts, of the intensity at depth with two anterior, two posterior, and two lateral ports, showed that the intensity at the 10 cm depth had increased to only 66 per cent, with all skin areas receiving 100 per cent at a radium-skin distance of 10 centimeters. Greater intensities than these were desired, in order to effectively radiate the deep seated lesions. Of course, a greater intensity could be obtained for mid-pelvic regions, by using the pack at a distance of 15 centimeters, but the treatment time would be lengthened to such an extent, especially with multiple ports, that this method was found to be impractical with the amount of radium available. Furthermore, at this distance, more radiation penetrates to the opposite skin surface, which necessarily reduces the dose which can be applied to

CHART I

Ra-S D	New Pack		Four gram Pack		
	1 Section	3 Sections	6 cm	10 cm	15 cm
	10 cm	10 cm			
Surface Int	63 r/gm hr	69 r/gm hr	86 r/gm hr	50 r/gm hr	28.5 r/gm hr
Depth	%	%	%	%	%
0 cm	100 0	100 0	100 0	100 0	100 0
1	88 8	91 0	87 5	91 0	91 0
2	76 5	80 0	71 5	76 0	80 5
3	65 3	72 5	59 1	65 1	71 0
4	55 0	67 6	49 3	56 1	62 0
5	46 3	64 0	41 3	49 0	54 0
6	40 0	60 8	34 7	42 4	47 5
7	33 3	58 0	29 1	36 7	42 0
8	29 5	55 0	24 6	31 8	36 7
9	25 6	51 6	21 3	27 5	32 3
10	22 2	48 0	18 7	24 0	28 5
11	19 9	43 8	16 6	21 3	25 7
12	16 7	39 3	14 9	19 0	23 5
13	13 3	35 0	13 3	17 3	21 2
14	12 2	31 2	12 0	15 6	19 3
15	10 5	27 8	10 8	14 2	17 5
16	8 6	25 0	9 8	13 0	16 2
17	7 1	22 2	8 9	11 8	14 8
18	5 9	20 1	8 0	10 8	13 5
19	4 8	18 5	7 3	10 0	12 3
20	3 8	17 0	6 7	9 1	11 5

The surface intensities as listed include tissue scattering

amount of healthy tissue damage, together with the increased depth intensity will prove to be an improvement over previous methods, remains to be determined. Some research on the treatment of deep-seated lesions with this pack is now in progress.

SUMMARY

A cross-firing 4 5-gram radium pack is described. Charts showing surface and

depth intensities as well as isodose curves are presented.

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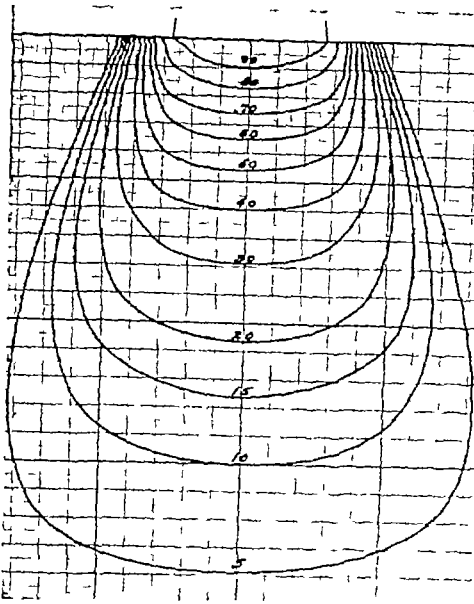


Fig 4 Isodose chart for single section when used separately

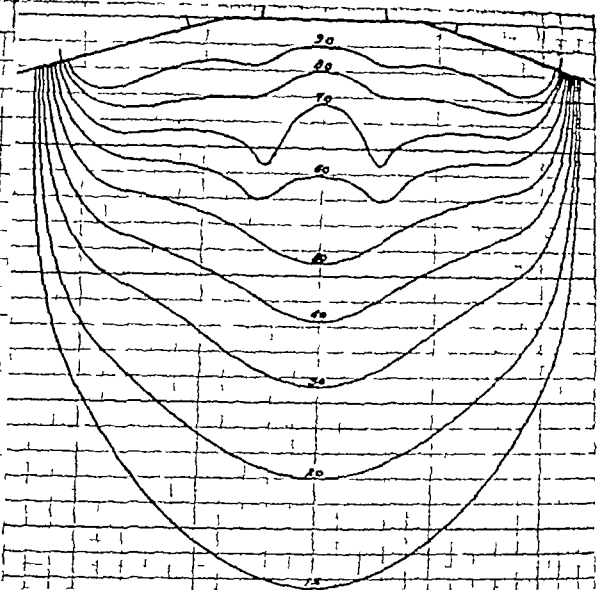


Fig 5 Isodose chart for the three section pack

and in part to the difference in the height of the radium column

The fact that the trays containing the radium are removable makes this arrangement as flexible as possible. For example, two of the trays may be inserted into the former pack, so that it may be used on those particular lesions for which it is best suited, or the cannons may be separated and each may be suspended as an individual pack, making it possible to treat three patients at one time.

The beams emitted from a single section and from the three sections as a unit, were explored by a thimble ionization chamber in order to obtain values to be used in the construction of isodose charts. Figure 4 shows the isodose curve for a single cannon and Figure 5 that of the three-section pack.

The primary filter is one millimeter of platinum. The secondary filter, next the skin, consists of one millimeter of copper and one millimeter of aluminum. With this arrangement of the radium in the three cannons, as described, and the filters mentioned, the rate of dosage is 1.72 r²

per minute on the skin directly under the middle portal.

For purposes of comparison, Chart I is included, which shows the surface and depth intensities, on the central ray for the 4-gram pack, for the single cannon and the three cannons as a unit. It can be seen readily from this chart that the depth intensities have been greatly increased by this arrangement.

Application of this pack to the anterior and posterior surfaces of a patient 20 centimeters in antero-posterior dimension, produces an intensity at a depth of 10 centimeters or at the midpoint of the pelvis, of 82 per cent, with all the skin surfaces receiving 100 per cent. This depth intensity is the same as that produced by x-rays of effective wave length 0.16 Å at 80 centimeters TSD with a field size of 20 × 20 centimeters.

The volume of tissue irradiated with this method is considerably less than when four fields are radiated by the 4-gram pack, or even when two fields are radiated with x-ray with the 20 × 20 centimeter field at 80 centimeters distance. Whether this decrease in the total volume irradiated with the accompanying decrease in the

* The instrument used was a Victoreen Condenser meter calibrated in roentgens for x-ray.

an organ, particularly one whose functions are many and not entirely understood, because of certain lapses from the course of normal function, may attain a desired end, but the means are certainly not in line with what might be termed scientific procedure. Methods or the search for methods of a corrective nature, which would tend to suppress excess activity or to stimulate functional inactivity, would seem more logical and more desirable. To remove from life's activities all criminals, near criminals, and potential criminals, no doubt would meet the wishes without disturbing the consciences of those with radical reform ideas, but it certainly would not square with the tenets of a true civilization.

The inhibitory action of radiation on all secretory glandular tissue, especially when in a hyper-functioning state, is well known to those members of the profession who have studied its effects or observed its action. Time will not permit a detailed review of the action of radiation in this respect.

Desjardins (19) gives a complete review of all experiments relative to the effects of radiation on the pancreas. Of interest to us are the experiments of Tsuzuki, 1926, which showed a distinct atrophy of the islands of Langerhans in rabbits after short wave radiation. A careful review of all the literature which we have been able to assemble shows no reference to the treatment of hyperinsulinism by radiation, except the case reported by the writer in *RADIOLOGY* of September, 1933 (page 296). This case, along with two others which are reported below, offer a suggestion for the further use of radiation as a possible agent in the treatment of hyperinsulinism of pancreatic origin.

Case 1 D W, a white female, age 9 years, weight, 65 pounds, height, 52 inches, whose general physical appearance was healthy, although she was mentally dull, listless, and inattentive. However, after eating, her expression would change to that of a person with normal mentality. Her physical examination disclosed no defects, Wassermann was negative, feces, blood counts, and basal metabolism were normal.

Her father, mother, one brother, and two sisters all seemed healthy and normal in every way. However, one aunt, aged 21 years, had been a confirmed epileptic since the age of 17 (Case 2). Otherwise the family history was negative.

When the patient was 5 years of age, her mother noted that the child at times seemed to be dull, listless, and stuporous, while again she was bright, cheerful, and playful. After some time it was noted that her stuporous spells occurred as her meal hours neared, and disappeared after eating. As time passed, she began to have "spells" (so described by her mother) accompanied by unconsciousness. The mother gradually learned with experience to guard against these attacks by feeding. At the age of 6, the patient entered school and found it up-hill work. In the hours immediately after eating, she could learn easily, but later she would forget what she had learned, recovering it, however, as soon as food was taken.

During all this time she received no medical attention and was known by neighbors and school children as being weak-minded. About Jan 1, 1933, Dr Powell, of West Monroe, was consulted and, with the above history, at once suspected the true condition. Along with other laboratory tests, all of which were negative, as stated, a series of fasting blood sugar tests were made, which ran from 40 to 50 mg per 100 c c of blood. On feeding every two hours, it never went higher than 73 mg. From January to April, 1933, she was kept on a low carbohydrate and high fat diet, with improvement in all symptoms.

On April 16, we administered 210 r, using 130 K V P, with 3 mm Al filter, over the anterior and posterior regions of the pancreas. From April 23 to 30, her daily fasting sugar test ran from 70 mg to 71 mg, on May 3, the same x-ray dose was given, and from May 7 to 15, her sugar test ran from 72 to 80 mg. On May 16, June 22, and July 23, one-half the above x-ray doses was given and her blood sugar came up to 100 mg. No further x-ray treatment has been given.

eating, early in the morning, or after a late or missed meal. Also, prolonged mental or physical exertion may precipitate an attack.

The diagnosis of hyperinsulinism rests upon the determination of a low blood sugar, though it must be remembered that low blood sugars have other causes than excessive insulin secretion.

Joslin (15) says that normal fasting blood should show 100 mg of sugar per 100 c c of blood. Like other normals, a reasonable percentage above or below is still classed within the normal limits. Low blood sugars do not react the same in all individuals. A hypoglycemia of 50 mg may develop no reaction in one, while in another, it may precipitate convulsions and coma. Low fasting sugar or low sugar, from three to six hours following a glucose meal, was noted by Tedstrom (11) in every one of 65 cases examined by him. According to Bowen and Beck (16), an attack is never seen in the absence of hypoglycemia, while Johns (17) found only 54 per cent showing hypoglycemia at the time of seizure.

Harris (18) says the dextrose tolerance test usually brings out much lower blood sugar levels than simple fasting tests, and in some instances the low levels were not seen until the fourth to sixth hour.

A positive diagnosis can be made only from repeated fasting blood sugar studies and carbohydrate tolerance tests showing hypoglycemia. Weakness, hunger, nervousness, mental lapses, irritability, sweating, trembling, etc., occurring at intervals and relieved by eating, suggest a diagnosis of hyperinsulinism. If accompanied by low fasting sugar or low sugar, with dextrose tolerance tests, the diagnosis is positive.

Low blood sugar—hypoglycemia—is found in many conditions in which true hyperinsulinism does not exist. Diseases of the liver, in which the glycogenetic function is impaired, would naturally result in a reduced quantity of sugar in the blood. This is seen in extensive carcinoma of the liver, and in some cases of cirrhosis, arsenic and phosphorus poisoning, etc. A deficient

intake of proper carbohydrate diet will sometimes result in low blood sugar levels if prolonged in practice. Over- and prolonged muscular exercise and generalized disease of the skeletal muscles, such as progressive muscular atrophy, have the same result.

It is claimed that the internal secretions of the ovaries, testes, and parathyroids are synergistic with insulin and tend to reduce the blood sugar, and that the secretions of the pituitary, thyroid, and adrenal glands tend to raise blood sugar. Low blood sugars from these varied sources usually are readily suspicioned and the symptomatology of disease of these organs and glands readily identified.

The treatment of hyperinsulinism by diet has rather generally resolved itself into a high fat and low carbohydrate feeding, the idea of Harris being that excessive carbohydrate intake stimulates the insulin system to increased activity. In many mild cases, this plan has worked apparent cures, in severe types, the attacks are not thus controlled and resort must be had to frequent carbohydrate feeding, as insulin is used in diabetes, with the hope of only controlling the disease.

Reference has already been made to surgical treatment of hyperinsulinism. The procedure has been eminently successful in those cases in which adenomas were present. In cases in which portions of the pancreas have been removed, in which no adenomas were found, surgical treatment has generally failed. In Harris' case (7), which resulted in a cure, it is probable that small adenomas were present but not detectable.

The hope has been expressed that surgeons may learn ultimately just how near they may approach total excision of the pancreas to effect a cure in islet hyperplasia and idiopathic cases. This may probably come true, yet to many it appeals as a search for the remedy in the wrong direction. It would seem that history may repeat itself, and the treatment followed by surgeons in cases of hyperthyroidism may find a parallel in their views of hyperinsulinism. The total removal or destruction of

two times per week, frequently early in the morning on first awakening. Attacks seem to be getting more and more severe. Between attacks, the child is bright and seemingly normal.

The patient was treated two years ago with x-rays for supposed enlargement of the thymus, with no results. He came under the care of Dr. J. D. Young, in April, 1933, at which time he was placed in the hospital where complete physical and laboratory examinations were made, which were essentially negative, except for the blood sugar, which ran, on fasting, from 72 to 80 mg. On April 24 and 25, 1933, while in the hospital, he had convulsions at 6:30 o'clock each morning. Nerve sedatives and diet seemed to have little effect in relieving the condition.

On July 1, 1933, he was referred to us for treatment, at which time his blood sugar fasting was from 70 to 80 mg, all of the symptoms described above being present and seemingly increasing in severity. Between July 9 and August 21, six x-ray treatments were given over the pancreas, using 90 K V P, 3 mm Al, less than a fourth erythema dose being given. On August 21, the blood sugar was 94 mg and attacks had ceased. On Sept. 21, 1933, his blood sugar was 100 mg, on Oct. 11, 1933, it was 106 mg. The child has had no further attacks and his mother writes that he seems to be normal in every way.

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Coincident with the improved blood sugar content, her general condition improved and her mentality rapidly came up to normal. She now takes zealous interest in all things that interest children of her age, and has no spells or stuporous periods.

Case 2 Miss V W, a white female, aged 21 years, height, 63 5 inches, weight, 137 pounds, began menstruation, which was always normal, at the age of 14 years. She finished high school at the age of 18, with good grades. Being an athletic enthusiast, her general physique was above normal.

Her three brothers and three sisters were all in perfect health, her father and mother were in good health. However, she had an aunt who was subject to epilepsy, and one niece, aged 9, who suffered with hyperinsulinism. The family history was otherwise normal.

At the age of 17, she had a convulsion, during which she chewed her tongue. There were no premonitory symptoms. From then on her convulsive seizures were grand mal in type, and continued at intervals of from three or four days to thirty days. She was treated for epilepsy by several doctors, but to no avail. In May, 1933, the patient consulted Dr. Powell, of West Monroe, she was then having convulsive seizures, grand mal, from every three or four days to ten days. General physical and laboratory examinations disclosed nothing abnormal, excepting a fasting blood sugar of 45 mg, and a general mental aspect of dullness, disinterestedness, and inattentiveness, and impressed one as being stupid. She was placed on a carbohydrate diet and frequent feedings, but with no results. A change was then made to a diet of high fat and low carbohydrate content, with the result that the severity of the attacks was lessened and there was some improvement of her general mental picture.

On May 23, 1933, she was referred to us, at this time her blood sugar was running from 80 mg to lower levels, having convulsive seizures and mental picture as described. The low carbohydrate and high fat diet

was continued and she was given radiation over the pancreas, anterior and posterior, 210 r, using 125 K V P, with 3 mm Al filter. This dose was repeated one week later when her blood sugar was found to be only 60 mg, convulsive seizures and mental picture still unchanged. On June 9, blood sugar was 66 mg, convulsions and mental picture remaining the same. On this date she was given 560 r, using 200 K V C P, with 0.5 mm Cu filter, over the pancreas, anterior and posterior. Two weeks later, June 23, her blood sugar was 90 mg, convulsive seizures less severe and not as frequent. On this date and on July 7, the same doses were repeated, at which time the blood sugar was 100 mg. Her convulsive seizures were very light and infrequent, with a complete transformation in her mental appearance, alertness, and interest, a change to a bright, smiling, cheerful, vivacious individual, as compared to the dull, inattentive, disinterested, dumb mentality of six weeks previous. On July 21, her blood sugar was 100 mg, and during August it ran from 106 to 120 mg, during which time she had only one or two light attacks and these at times when home surroundings became such as to upset even one with a normal nerve balance.

In September, this patient developed an acute double mastoiditis, was operated upon and died.

While the results in this extreme case of hyperinsulinism were not all that were to be desired, quoting the words of Dr. Powell, under whose eye she was constantly, "It definitely indicates the inhibitory action of radiation in hyperinsulinism."

Case 3 P T, white, male, age 5 years (normal delivery), was a thoroughly normal child for the first three years of life. Two years ago he began to have "spells," turning blue, with nervous twitchings and loss of consciousness. These spells came on at times suddenly, at other times, gradually and at times headache and pain in the stomach preceded the spells. At one time he had convulsions constantly for twenty-four hours, recently has had spells one to

two times per week, frequently early in the morning on first awakening. Attacks seem to be getting more and more severe. Between attacks, the child is bright and seemingly normal.

The patient was treated two years ago with x-rays for supposed enlargement of the thymus, with no results. He came under the care of Dr. J. D. Young, in April, 1933, at which time he was placed in the hospital where complete physical and laboratory examinations were made, which were essentially negative, except for the blood sugar, which ran, on fasting, from 72 to 80 mg. On April 24 and 25, 1933, while in the hospital, he had convulsions at 6:30 o'clock each morning. Nerve sedatives and diet seemed to have little effect in relieving the condition.

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EXPERIENCES IN THE IRRADIATION TREATMENT OF HYPERTHYROIDISM¹

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INTRODUCTION

IN THE University of Chicago Clinics the great majority of cases of hyperthyroidism are treated surgically, and irradiation is employed only in post-operative recurrences or in cases in which, for some reason, operation cannot be performed. This paper is a report of the immediate results obtained by irradiation in the latter two categories of cases.

Menville's nation-wide survey of 1932 includes 10,541 cases of hyperthyroidism which had been treated by irradiation. Of these, 66 per cent were listed as cures, 21 per cent showed marked improvement, and 12 per cent failed to respond. Pfahler and Christie have reported a much higher incidence of favorable responses.

There is a great variation in the technical factors employed. Voltage has ranged from 125 K V to 200 K V, minute intensity from 5 r per minute to 30 r per minute, and total intensity from 500 r to 1,800 r, administered to one large portal or each of several smaller portals. In spite of these technical differences there is a rather striking uniformity in the clinical response. This implies that maximum response is possible by small doses of x-ray and is independent of wave length over a wide range. There seems to be no essential difference between the results obtained by radium or by x-rays. A choice between the two depends upon the type of facilities available.

The relative value of irradiation therapy and surgery in the treatment of hyperthyroidism is still subject to debate. A final decision will be hastened if surgeons and radiologists will forego prejudice and develop self-criticism, emphasizing their own failures rather than their successes.

Of special value would be clinical studies of individual cases that did not respond to one of these forms of treatment but were benefited by the other.

It is beyond the scope of this report to review in detail the literature on the surgical and radiological treatment of hyperthyroidism. Suffice to state that one form or the other may, on the basis of reports published by leading surgeons and radiologists, be justified as the treatment of choice. For example, DaCosta reports that the surgical statistics usually show about 90 per cent rate of "cures," while practically equal percentages of "cures" are reported for irradiation therapy by Pfahler and Christie.

As regards surgical mortality, Richter reports 0.89 per cent in 1,200 cases, and Crile 0.84 per cent in 5,000 cases. The average surgical mortality is perhaps more correctly stated as between 3 and 4 per cent. In this respect, irradiation would seem to have an advantage since its mortality is negligible. However, such low mortality ascribed to irradiation may be due to the fact that the amount of irradiation given is generally regarded as innocuous in so far as danger to life is concerned, and any fatality occurring during the period of treatment is ascribed to the patient's disease rather than to the method of treatment.

The usual surgical treatment entails enforced bed rest for a period of from two to four weeks, whereas the treatment by irradiation is an ambulatory one and the patient need have but very little interruption of his normal daily activity. It will be objected by some that irradiation therapy is very time-consuming and that the patient will be subnormal for long periods. In our experience the patient usually shows definite improvement within a month's time following the beginning of

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis Tenn. Dec 3-7 1934

treatment, and usually it does not require more than two or three months to attain the maximum beneficial effect

Response to irradiation appears to be independent of the pathologic type of the goiter Pfahler is convinced that irradiation does not increase the tendency to malignant degeneration

ANIMAL EXPERIMENTS

In experiments conducted on dogs, Walter, Anson, and Ivy have shown that clinical doses of irradiation do not alter the histology of the normal thyroid gland. Fibrosis occurs only when intensity is so great as to cause ulceration of the overlying skin, and when it does occur it is confined largely to the capsule of the gland. Experimental hyperthyroidism produced in opossums by Bensley's method of high protein feeding can be prevented by irradiating the animals either before or during the feeding period. This experiment suggests a useful field for irradiation in the post-operative management of hyperthyroidism. There are no clinical studies available on such a procedure.

PRESENTATION OF CLINICAL MATERIAL

Twenty-eight patients have been irradiated in the University of Chicago Clinics in the past two years. Since the follow-up

period on the majority of them is short, results will be considered only in the light of immediate response. For all of these patients the technical factors were the same: 200 K V, 25 ma, 1 mm Cu and 1 mm Al filtration, and 50 cm focal skin distance. Most patients were treated using three portals: two 10 × 12 cm portals, one to each lobe of the thyroid, and a 10 × 10 cm portal over the upper mediastinum. Two treatments of 300 r each (measured in air) were given to each portal, treating one portal daily for a total of six days. However, in one instance tracheal irritation was produced and, following this, treatments were given to one large field, 15 × 15 cm, which included all of the neck and upper mediastinum. Three treatments of 200 r each, given on successive days to this one portal, are considered a series. This series is not repeated in less than a month but is repeated on successive months until the desired effect is accomplished.

Of the 28 cases treated, 17 are now definitely without clinical manifestations of hyperthyroidism, four have been very definitely improved, and seven failed to respond favorably to the treatment. Seventeen of the patients were suffering from post-operative recurrence of hyperthyroidism, 11 had not been operated upon. In addition to the patients' subjective statements, our criteria of improvement have included the following: (1) the basal

TABLE I—SHOWING THE EFFECT OF IRRADIATION ON 11 PRIMARY CASES

Patient	B M R		Pulse		Blood Pressure		Weight (kg)		Cured	Improved	Failure
	Before	After	Before	After	Before	After	Before	After			
L H	+48	+15	99	85	116/66	114/72	54.9	65.1		x	
A D	+30	+15	98	93	152/88	140/80	59.7	49.8		x	
G E	+42	+30	106	109	160/90	130/74	57.3	51.4			x
L C *	+44	- 3	93	70	110/68	120/84	56.2	66.0	x		
R S	+33	+ 5	96	88	126/58	108/72	56.7	57.6	x		
M O	+28	+27	75	91	138/80	140/80	54.7	59.9			
M L	+32	- 3	108	85	110/70	100/70	55.0	56.1	x		x
A M	+18	+18	95	93	134/70	124/64	52.0	50.2			x
T M	+64	+ 9	92	66	156/78	148/80	76.5	84.5	x		
M R *	+44	+16	107	93	130/70	140/80	57.0	56.1		x	
A G	+40	+28	97	82	156/90	124/70	71.4	72.5			x
Total											
									4	3	4
Average	+38	+14	97	88	135/75	126/75	59.2	60.8	36%	28%	36%

* Received iodine during and after irradiation

metabolism, (2) pulse, (3) blood pressure, (4) weight. No patient has been considered cured unless all criteria have shown favorable responses.

Considered as a whole, the group of 28 patients responded to irradiation as follows: basal metabolic rate before irradiation +35, after +9, pulse before irradiation 97, after 79, blood pressure before irradiation 132/76, after 123/75, weight before irradiation 58.5 kg, after 61.8 kg. It will be seen that the metabolic rate was reduced 26 points, the pulse reduced 18 beats per minute, and the pulse pressure reduced 8 mm, while the weight was increased 3.28 kg, or 7.2 pounds.

When reviewed, the group of 17 cases considered as "cures" showed the following: B M R before irradiation +32, after -2, pulse before irradiation 99, after 76, weight before irradiation 56.7 kg, after 61.1 kg, blood pressure before irradiation 130/72, after 119/74. Thus this group showed a drop of 34 points in B M R, the pulse was lowered 23 beats per minute, and the average weight gained was 4.4 kg, or 9.6 pounds, while the pulse pressure was reduced 13 millimeters.

The post-operative group, 17 in all, when

reviewed collectively showed the following: B M R before irradiation +31, after +5, pulse before irradiation 97, after 79, blood pressure before irradiation 131/74, after 123/76, weight before irradiation 57.5 kg, after 61.6 kg. Thus the B M R was reduced 26 points, the pulse dropped 18 beats per minute, and the pulse pressure was reduced 10 mm, while there was a gain in weight of 4.1 kg, or 9 pounds. Thirteen of this group are clinically free from symptoms, one is markedly improved, while three failed to receive any benefit from the treatment.

When taken as a whole the group in which no operative procedures had preceded irradiation showed the following: B M R before irradiation +38, after +14, pulse before irradiation 97, after 88, weight before irradiation 59.2 kg, after 60.8 kg, blood pressure before irradiation 135/70, after 126/75. The B M R was reduced 24 points, the pulse was lowered 9 beats per minute, the pulse pressure was lowered 14 mm, while the weight increased 1.6 kg, or 3.5 pounds. Of this group, four are clinically free from symptoms, three improved, and four unimproved.

TABLE II—SHOWING THE EFFECT OF IRRADIATION ON 17 CASES OF POST-OPERATIVE RECURRENCE

Patient	B M R		Pulse		Blood Pressure		Weight (kg)		Cured		
	Before	After	Before	After	Before	After	Before	After	Improved	Failure	
K. G	+32	+2	96	84	120/88	108/88	54.8	59.2	x		
E. B	+19	+5	80	70	130/84	134/88	64.8	65.9	x		
M. K	+25	-13	116	73	122/64	110/70	36.1	43.8	x		
M. G *	+47	+21	93	82	150/98	140/80	63.3	77.4		x	
D. A	+31	+28	81	90	116/70	126/88	73.6	74.0			x
B. C	+24	-11	98	60	120/70	106/64	65.9	73.0	x		
G. B	+24	-12	85	67	128/80	130/74	56.6	58.7	x		
L. C	+32	+8	85	65	150/70	140/80	49.1	51.6	x		
H. L	+33	+4	101	97	170/80	140/82	50.3	63.0	x		
P. Z †	+44	+36	81	85	146/80	144/84	55.5	61.9			x
G. P	+20	+5	106	91	118/70	120/74	74.3	75.7	x		
R. M	+38	-9	123	79	126/80	110/76	50.8	61.3	x		
M. W	+37	-21	110	80	154/82	116/74	69.2	76.3	x		
A. M *	+28	-2	114	79	132/80	116/74	47.6	50.5	x		
S. M	+19	-14	73	58	120/70	110/60	38.2	40.4	x		
G. S *	+43	+50	101	98	106/66	120/70	66.0	58.5			x
E. S	+34	+8	110	85	120/64	114/64	55.8	57.3	x		
Total									13	1	3
Average	+31	+5	97	79	131/74	123/76	57.5	61.6	76%	6%	18%

* Received iodine during and after irradiation

† Did not finish treatment

In comparing these groups it will be readily seen that the best results have been with patients suffering from post-operative recurrence of hyperthyroidism. The percentage of "cures" in this group is 76 while in the primary group it was only 36.

The results obtained in post-operatively recurrent hyperthyroidism treated by irradiation have proved so satisfactory that irradiation is felt to be the treatment of choice under these circumstances and should be considered, all conditions permitting, before re-operation is recommended. On the other hand, although experience in the primary treatment of hyperthyroidism by irradiation is limited, it is believed that irradiation therapy may well be recommended as the primary treatment in cases of mild or even moderately severe hyperthyroidism of long standing in which, for other medical or non-medical reasons, an operation is to be avoided if at all possible.

Lugol's solution was given to four patients. One received it inadvertently, having taken it before coming for irradiation. She continued its use throughout treatment, doing so on her own responsibility. On two other occasions the metabolic rates after treatment had been reduced but not to normal and, as supplementary treatment, small doses of iodine were given for a short time with satisfactory response. The fourth patient to receive iodine was influenced by neither irradiation nor iodine and was later operated upon.

SUMMARY AND CONCLUSIONS

(1) In the literature it is reported that permanent clinical cures of hyperthyroidism in a great majority of large series of

cases may be brought about by irradiation therapy alone.

(2) The question as to whether surgery or irradiation is the primary treatment of choice in hyperthyroidism is not finally settled.

(3) In the small series of cases here presented in which primary irradiation was given because operation was refused or was for medical reasons contra-indicated, the primary results are not comparable with what might be expected from a similar number of patients operated upon.

(4) In certain cases of mild or moderate hyperthyroidism existing for a long period, or in cases in which for certain reasons operation is to be avoided if at all possible, irradiation is indicated. It should be realized, however, that operation may eventually have to be performed.

(5) In the small series of cases presented, results of irradiation in post-operatively recurrent hyperthyroidism have been very gratifying. In this group, irradiation is considered the treatment of choice and well worth trying before re-operation is contemplated.

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TABLE II—SHOWING THE EFFECT OF IRRADIATION ON 17 CASES OF POST-OPERATIVE RECURRENCE

Patient	B M R		Pulse		Blood Pressure		Weight (kg)		"Cured"	Improved	Failure
	Before	After	Before	After	Before	After	Before	After			
K. G	+32	+2	96	84	120/88	108/88	54.8	59.2	x		
E. B	+19	+5	80	70	130/84	134/88	64.8	65.9	x		
M. K	+25	-13	116	73	122/64	110/70	30.1	43.8	x		
M. G *	+47	+21	93	82	150/98	140/80	63.3	77.4		x	
D. A	+31	+28	91	90	116/70	126/88	73.6	74.0			x
B. C	+24	-11	98	60	120/70	106/64	65.9	73.0	x		
G. B	+24	-12	85	67	128/80	130/74	56.0	58.7	x		
L. C	+32	+8	85	65	150/70	140/80	49.1	51.6	x		
H. L	+33	+4	101	97	170/80	140/82	50.3	63.0	x		
P. Z †	+44	+36	81	85	146/80	144/84	55.5	61.9			x
G. P	+20	+5	106	91	118/70	120/74	74.3	75.7	x		
R. M	+38	-9	123	79	126/80	110/76	56.8	61.3	x		
M. W	+37	-21	110	80	154/82	116/74	69.2	76.3	x		
A. M *	+28	-2	114	79	132/80	116/74	47.6	50.5	x		
S. M	+19	-14	73	58	120/70	110/60	38.2	40.4	x		
G. S *	+43	+50	101	98	106/66	120/70	66.0	58.5			x
E. S	+34	+8	110	85	120/64	114/64	55.8	57.3	x		
Total									13	1	3
Average	+31	+5	97	79	131/74	123/76	57.5	61.6	76%	6%	18%

* Received iodine during and after irradiation.

† Did not finish treatment.

elaborate substances that tend to raise blood sugar and neutralize the effects of insulin. The pathologic state appears when some dysfunction of either or both glands occurs. This dysfunction is considered likely to be a hyperfunction, at least the roentgen-ray application herein described was given at first with that idea in mind. But, while we are reporting a measure of success in a large majority of the cases treated, we are not in a position to declare ourselves positively regarding the exact process of the relief obtained.

For this reason it is difficult also to bring objective evidence, other than that of the sphygmomanometer, to support the claim to relief of hypertension. And sometimes the reading does not appear to be substantially reduced, despite the patient's insistence that he is better. Nevertheless, the subjective evidence of the patient's self-reported improvement in the sense of well-being and relief from headache, tinnitus, vertigo, and other symptoms may properly be given some credence since they are almost constant following this treatment, despite widely varying conditions of physical and mental states.

THE DATA ON WHICH THIS THEORY IS BASED

The Pituitary Body—The influence exerted by the pituitary on adrenal development and function is rather well established and generally accepted. Our knowledge is based on the degeneration of the adrenals after hypophysectomy, the repair of this degeneration after pituitary transplants, and on the studies of Evans (10), Collip (11), and others, who have extracted an adrenotropic substance from the anterior lobe of the pituitary. Other considerations are as follows:

The adrenal enlargement (usually with hypertension) sometimes found in acromegaly with acidophilic pituitary tumor.

The secondary adrenal hyperplasia occurring in the Cushing syndrome, which he traces to a basophilic adenoma of the pituitary and the hypertension which is a constant of that syndrome.

The work of Moehlig and Osius (12),

who fed animals a high fat diet, with daily pituitrin injections, and produced a pronounced arteriosclerosis and marked hyperplasia of the adrenal cortex within 100 days.

Cushing's (9) observation that all known primary pituitary disorders cause marked secondary changes in the adrenal cortex.

The extremely low blood pressure which is characteristic of Simmonds' disease, a condition generally accredited to almost complete functional breakdown of the anterior lobe, in which adrenal deterioration is part of the general picture.

Moehlig and Bates (13) say

"Kraus and Traube examined 232 pituitaries of persons who had been ill but a short time, so that no change in the pituitary would be expected from the illness. Another group was obtained from persons who had either died by accident or had committed suicide."

Among the conclusions were the following:

"Normal persons of hypersthenic habitus show, as a rule, a marked increase of the basophil cells as compared with those of the healthy mesosthenic habitus."

"Persons with diseases which attack, as a rule, the hypersthenic type, such as essential hypertension, vascular sclerosis, contracted kidneys, constitutional obesity, and, in a certain degree, chronic alcoholism, progressive paralysis, and aortitis of syphilitic origin, show a very high percentage of basophil cells and a marked increase of the basophil cells as compared with the mesosthenic type."

"Persons with high blood pressure, chronic nephritis, and so-called secondary contracted kidneys also have a marked increase of the basophil cells as compared with the normal mesosthenic type."

"Asthenic persons, such as the diabetic and the tuberculous types in whom the blood pressure is low, show a diminution of the basophil cells in a majority of cases."

"As to the relationship between the basophil cells of the pituitary and the suprarenals, 72.7 per cent of the persons with suprarenals rich in lipid (12 gm or more) show a marked increase of the basophil cells."

"Our studies on these 232 pituitaries taken from normal and sick persons permit the conclusion that there is a definite relationship between the basophil cells of the pituitary and the constitutional type of the patient, likewise between these and the blood pressure as

RADIOTHERAPEUTIC TREATMENT OF HYPERTENSION AND DIABETES¹

By JAMES H. HUTTON, M.D., *Chicago*

HIGH in the list of causes of death, its proportionate toll increasing, stands the group of pathologic conditions summed up as "essential hypertension" and its allied disorders. Fahr (1) calculated that, in 1924, 140,000 deaths in the United States were due to hypertension or its consequences. This was 23 per cent of all deaths of persons over 50 years of age. Its predilection for brain workers and consequently for some of our most able citizens makes it of far-reaching economic and social importance and, among other considerations, makes it paramount among the problems confronting medicine to-day. It is hoped that these considerations offer justification for presenting to you a new theory as to the etiology and treatment of this syndrome and our experience with therapeutic efforts based on this theory.

Briefly, it is believed that essential hypertension is largely a matter of endocrine dysfunction, probably over-activity, and that this activity can be controlled by means of the roentgen ray.

In 1913, Quadroni (2) reported his experience in the treatment of this syndrome by x-raying the adrenals. How far he proceeded along this line or with what results, I do not know. Since that time almost every book written on the subject has mentioned, for the most part very briefly, the possibility that the adrenals or other of the endocrine glands might have some influence in bringing about hypertension. In recent years four surgical procedures have been devised for the treatment of this syndrome, all directed, in part at least, at the adrenals and designed to reduce their functional activity

to a lower level. DeCourcy (3) removes surgically about two-thirds of each adrenal. Crile (4) and Arn (5) have for several years been doing a denervation operation not only for hypertension but also for recurrent hyperthyroidism, peptic ulcer, and neuro-circulatory asthenia. The Mayo Clinic (6 and 32) has published descriptions of resection of the major and minor splanchnic nerves uni- or bilaterally, and of a technic for severing the anterior roots of the spinal nerves from the sixth thoracic to the second lumbar inclusive (7). Publication of these operative technics offers some support for the idea that the adrenals' functional level is important in the production of essential hypertension. Trolow (8) and his associates report some success in the treatment of essential hypertension by the application of diathermy to the adrenals and neighboring structures.

As far as I know, Cushing (9) was the first to call attention to the fact that the pituitary might be responsible in some instances for this syndrome.

For something more than two years the writer, in co-operation with Dr. G. G. Dowdall, Chief Surgeon of the Illinois Central Railroad, and various members of the medical staff of the Illinois Central Hospital, have proceeded on the hypothesis that the pituitary and/or adrenals were responsible for most cases of essential hypertension, and have attempted to relieve them by x-raying these structures. We believe that our results warrant further study on a larger scale.

Specifically, the endocrine theory of essential hypertension is as follows. The pituitary supplies a functional impetus to the adrenals and itself secretes substances affecting the blood pressure. The adrenals exercise a direct effect on the pressure level. Both the adrenals and the pituitary

¹ Presented before the Radiological Society of North America, at the Twentieth Annual Meeting in Memphis, Tenn., Dec. 3-7, 1934.

in the male, although this phase is not usually investigated (We have noted sexual impotence in a number of young men victims of essential hypertension, but this is by no means a constant finding)

Alvarez (20) notes

"It is suggestive also that in young women, there seems to be a high degree of correlation between the incidence of hypertension and the presence of the various symptoms and signs of ovarian hypofunction. It would seem that the internal secretion of the ovary is able in some way to suppress the tendency to hypertension which many of the girls presumably inherit equally with the men."

Goldzieher (16-c) adds

"The relation between the climacterium in women and hypertension is also striking and many theories have been built up on the conception that functional disturbances of the ovary and hypertension are closely connected. The frequency of hypertension in artificially sterilized women is particularly noteworthy and so is the coincidence of myoma and hypertension."

Fluhmann (21) found an excess of the anterior pituitary sex hormone in women past the menopause. More than ten years ago Marañon (22) noted his opinion that the adrenals take on added activity at the menopause.

Behind this association of hypertension and lowered flow of gonadal hormones lies the fairly well established idea that the internal secretions of ovary or testicle tend to suppress or balance pituitary function. Supporting this idea are the following:

(1) The inhibition of the growth impetus and closure of epiphyses when the gonadal function develops at puberty.

(2) The scarcely repressed growth of long bones, with resulting eunuchoid proportions, occurring in pre-puberal castrates or individuals in whom genital development does not occur because of disease, injury, or other causes.

Barnes, Regan, and Nelson (23) believed that the ovarian hormone could suppress pituitary activity. They apparently demonstrated the correctness of their idea by showing that female dogs to which

amniotin had been administered experienced only mild diabetes following pancreatectomy. When the injections of amniotin were discontinued, the animals became severely diabetic. Resumption of the injections was followed by a reduction in the severity of the diabetes.

This idea of an endocrine dyscrasia as the cause of essential hypertension is not novel nor entirely original. Quadroni's publication has been referred to and Hofbauer (24) suggested roentgen irradiation of the pituitary in hypertension more than 10 years ago, but did not use the treatment. The adrenal-denervation operations already mentioned, Alvarez' ideas quoted above, the French reports (25 and 26) of adrenal irradiation in hypertension, taken together, indicate that experienced physicians have had the germ of the idea in their minds for an appreciable time, but comparatively little seems to have been done about it. It has been our experience that, the more study and thought one gives it, the more inescapable and the more cogent it becomes. That it needs study there is no denying, but neither is it possible to maintain that it is not worth study. The physiology of the phenomena on which we are reporting is not at all satisfactorily explained—we have made it clear, certainly, that the foregoing observations are only tentative—and much work remains to be done in that phase. This task, however, is beyond the time and facilities available to the present writer. This report is concerned with facts accumulated in the course of active private practice, where the prime and immediate necessity was to relieve the patient of his complaints.

Before passing to a description of the work we have been doing, it seems important to call attention again to the gradually emerging idea of the paramount importance of the pituitary body in many of the physiologic problems confronting medicine. This is especially true of the anterior lobe, where growth, sex, adrenotropic, thyrotropic, lactogenic, and diabetogenic principles have been rather defi-

well as the state of the suprarenals. In other words, there is a definite relationship between the basophil cells, the constitutional make up of the patient, the blood pressure, and the size of the suprarenals.

"There is, apparently, also a relationship between the basophil cells of the pituitary, the cholesterol content of the blood, and the suprarenals. This is important because of the relationship between the cholesterol content of the blood and vascular disturbances."

Dr J. D. Kirshbaum (14) has told me of six cases observed in Dr Jaffe's laboratory at the Cook County Hospital. Three cases of uremia, two cases of hypertension, and one of hypertension plus diabetes revealed an increase in the number of basophil cells in the anterior lobe of the hypophysis.

Cushing (15) recently reported the finding of a heavy infiltration of basophilic elements in the posterior lobes of six out of nine pituitary bodies from fatal cases of eclampsia, and in some glands from cases of essential or nephrovascular hypertension. He concluded that the source of these hypertensive disorders lies in the posterior lobe of the pituitary body.

The pharmacodynamic effects of pituitrin, many of which depend on its vasoconstrictor and vasopressor properties, constitute the direct influence exerted by the posterior lobe of the pituitary on the blood pressure. Exactly how the basophilic adenoma or hyperplasia brings about hypertension is not well understood.

The Adrenals—Adrenalin has long been recognized as having a definite effect on blood pressure and blood sugar. The increase in blood pressure and blood sugar resulting from sudden strain, excitement, fright, and exertion of any sort, is likewise to be ascribed, by Cannon's theory of adrenal function, to the outpouring of adrenalin into the blood stream.

There are numerous other supporting data. Of note is Goldzieher's (16-a) observation on adrenal tumors and their relation to blood pressure. He says

"In brief the writer claims that Volhard's arterial spasm or Munk's undefined 'hematogenous' hypertension is nothing else but a

symptom of over-activity of pressor endocrines and particularly of the phaeochrome system. I wish to state emphatically that I do not identify hypertension with mere hyperadrenalism, although adrenalin is the most powerful of the physiological pressor substances. There are other pressor hormones to be reckoned with, such as those of the pituitary and thyroid."

Another item is the frequency, as noted also by Goldzieher (16-b), with which various symptoms of increased sympathetic tonus, such as hyperglycemia, decreased glucose tolerance, and glycosuria, are associated with hypertension. Taken in consideration with the known effect of adrenalin in heightening sympathetic tension, this is, at least, suggestive.

The material here summarized has been collected and printed at length in the writer's three previous publications on this subject (17, 18, and 19).

Assuming the dependability of this assumed concatenation of pituitary influence on the adrenals and other endocrines, on blood pressure and blood sugar, and of adrenal influence on the blood pressure and blood sugar, it is possible to understand how a chronic or persisting pituitary-plus-adrenal over-activity or dysfunction could produce the state we call "essential hypertension," combined with various other symptoms, all possibly more or less dependent on the increased arterial tension. And it is obvious that an attack on the excessive or disordered activity of these two structures should be made in the effort to relieve the patient. It is on that basis that the application of roentgen ray to the pituitary and adrenals is suggested.

The question of why the pituitary and the adrenals should indulge in a disturbed or hyperfunctional activity in middle life cannot be definitely answered, but there are grounds for urging investigation of the possibility that a decline of the sex hormone supply is an important factor. For instance, essential hypertension is most frequent at about the period of the decline of potency. It is a common accompaniment of the menopause and is probably as often associated with sexual deterioration.

in the male, although this phase is not usually investigated (We have noted sexual impotence in a number of young men victims of essential hypertension, but this is by no means a constant finding)

Alvarez (20) notes

"It is suggestive also that in young women, there seems to be a high degree of correlation between the incidence of hypertension and the presence of the various symptoms and signs of ovarian hypofunction. It would seem that the internal secretion of the ovary is able in some way to suppress the tendency to hypertension which many of the girls presumably inherit equally with the men."

Goldzieher (16-c) adds

"The relation between the climacterium in women and hypertension is also striking and many theories have been built up on the conception that functional disturbances of the ovary and hypertension are closely connected. The frequency of hypertension in artificially sterilized women is particularly noteworthy and so is the coincidence of myoma and hypertension."

Fluhmann (21) found an excess of the anterior pituitary sex hormone in women past the menopause. More than ten years ago Mara \tilde{n} on (22) noted his opinion that the adrenals take on added activity at the menopause.

Behind this association of hypertension and lowered flow of gonadal hormones lies the fairly well established idea that the internal secretions of ovary or testicle tend to suppress or balance pituitary function. Supporting this idea are the following:

(1) The inhibition of the growth impetus and closure of epiphyses when the gonadal function develops at puberty.

(2) The scarcely repressed growth of long bones, with resulting eunuchoid proportions, occurring in pre-puberal castrates or individuals in whom genital development does not occur because of disease, injury, or other causes.

Barnes, Regan, and Nelson (23) believed that the ovarian hormone could suppress pituitary activity. They apparently demonstrated the correctness of their idea by showing that female dogs to which

amniotin had been administered experienced only mild diabetes following pancreatectomy. When the injections of amniotin were discontinued, the animals became severely diabetic. Resumption of the injections was followed by a reduction in the severity of the diabetes.

This idea of an endocrine dyscrasia as the cause of essential hypertension is not novel nor entirely original. Quadroni's publication has been referred to and Hofbauer (24) suggested roentgen irradiation of the pituitary in hypertension more than 10 years ago, but did not use the treatment. The adrenal-denervation operations already mentioned, Alvarez' ideas quoted above, the French reports (25 and 26) of adrenal irradiation in hypertension, taken together, indicate that experienced physicians have had the germ of the idea in their minds for an appreciable time, but comparatively little seems to have been done about it. It has been our experience that, the more study and thought one gives it, the more inescapable and the more cogent it becomes. That it needs study there is no denying, but neither is it possible to maintain that it is not worth study. The physiology of the phenomena on which we are reporting is not at all satisfactorily explained—we have made it clear, certainly, that the foregoing observations are only tentative—and much work remains to be done in that phase. This task, however, is beyond the time and facilities available to the present writer. This report is concerned with facts accumulated in the course of active private practice, where the prime and immediate necessity was to relieve the patient of his complaints.

Before passing to a description of the work we have been doing, it seems important to call attention again to the gradually emerging idea of the paramount importance of the pituitary body in many of the physiologic problems confronting medicine. This is especially true of the anterior lobe, where growth, sex, adrenergic, thyrotropic, lactogenic, and diabetogenic principles have been rather defi-

nitely identified Houssay's work (27), repeated by Barnes (28) in Chicago, on pancreatectomized and hypophysectomized dogs, is an important beginning in this study, and it is sincerely to be hoped that this whole problem of pituitary physiology and its ramifications will soon be traced down for us. Of its tremendous and far-reaching importance there can no longer be any doubt. The idea of hypophyseal and adrenal dysfunction utilized in this work is applicable to Graves' disease and diabetes mellitus. We have, in fact, irradiated pituitary and adrenals in a few cases of diabetes and in some of hypertension and diabetes combined, with some success. Our experience in the treatment of diabetes mellitus with the x-ray gives hope that we shall eventually be able to control a great many cases by this means.

To date roentgen irradiation of pituitary and adrenals has been given to 123 patients who were victims of hypertension, and to 12 others who had both diabetes and hypertension.

Of the 123 hypertensives, seven could not be traced, 20 were unimproved, and 96 were definitely relieved, that is, freed of complaints and with blood pressure reduced. Some of the 20 unimproved had what we considered an insufficient amount of treatment, discontinuing on their own responsibility despite blood pressure reduction. A few were dropped after trial had indicated that they were not favorable candidates. Those are the figures, the percentage of improvement is 78.05.

The complaints referred to as relieved were mainly headache, vertigo, tinnitus, precordial pain, dyspnea, and lack of endurance. Headache has been relieved in practically every instance. Precordial distress has, oddly enough, not been mentioned by the patient in a number of cases until its disappearance was noted after several treatments. This is also true of "heart-consciousness." Vertigo and tinnitus are usually associated with the headache in the patient's story and seem to disappear as the headache goes. Perhaps the most spectacular and (to the patient)

the most satisfying result of treatment is the increased physical endurance most of them experience after a few treatments, they boast of it spontaneously and add that they are "more clear-headed" and can work better.

The response of blood pressure to x-ray treatment varies. In some cases in which there is a marked fall after the first treatment, there is usually a rise of several points but not to the original level. Under further treatment there is another reduction in blood pressure, but usually several treatments are required to bring it to the point obtained after the first. Some cases show no response (occasionally a rise) after each of several treatments and then experience a considerable drop on further treatments. In others the blood pressure appears to rise for about 72 hours after treatment and then declines considerably.

There is no question but that the symptomatic relief of patients is much more striking than the reduction in their blood pressure, in fact, a number have been almost completely relieved of their symptoms before they experienced any marked reduction in blood pressure. In some cases the blood pressure declines satisfactorily and then later rises, but without return of other symptoms. This raises the question as to whether the factor which causes the symptoms may not be distinct from that which is responsible for the abnormal blood pressure.

In some cases discomfort or headache follows treatment to the pituitary, particularly when a heavy dose is used, in such cases the headache is relieved by treating the adrenals, the interrelationship of these two organs being very close. We cannot decide in most cases which symptoms are due to pituitary dysfunction and which to the adrenals. Moehlig (13) notes in this connection as follows: "Primary disease of the suprarenal cortex is accompanied by a variable, but, nevertheless, definite, secondary change in the pituitary." And Cushing's observation that secondary adrenal changes are in-

variable in primary pituitary diseases has already been cited

By way of illustration, we append here summaries of our experience with some typical patients

Case 1 Mrs F, aged 51 years, stated that she had known of her hypertension for six years She was short of breath, tired easily, had a little vertigo, and lately had had some trouble with her eyes, the nature of which she did not understand Her blood pressure was 170/105, pulse 90 A physical examination revealed the following the heart was slightly enlarged to the left, but regular, no murmurs were heard, the tonsils were hypertrophied and appeared to be infected, the linea over the lower abdomen were quite marked, the fundi appeared normal She had had a hysterectomy ten years before for fibroids Her mother had died of a "stroke" and her father of "dropsy" Her brothers and sisters were free from hypertension as far as she knew The basal metabolic rate was plus 11 Urine showed an occasional trace of albumen, but was otherwise negative The total nitrogen was 7.9 grams per 24 hours Blood count showed hemoglobin, 90-95, red blood count 4,980,000, white blood count, 8,850, lymphocytes, 44 per cent, polymorphonuclears, 56 per cent Blood chemistry showed non-protein nitrogen, 18.4, uric acid, 2.01, and sugar, 60.1 The glucose tolerance was

not done Phenolsulphonephthalein test returned 60 per cent of the dye in one hour Under amyl nitrite the blood pressure dropped to 164/102 After two x-ray treatments the blood pressure was 130/80, pulse, 60 Precordial pain, which she did not mention at her first visit, she said had disappeared She explained that she tired much less easily than when treatment was instituted

Case 2 Mr A, aged 40 years, height 6 feet, weight 197.5 pounds, had known of his hypertension for 12 years The highest reported reading was 250/150 He had had precordial pain for 18 months and had been sexually impotent for two years He had always been a hard worker and worried a great deal Two months before I saw him, he had had a left splanchnic nerve resection with little or no relief When he first came under observation, Sept 14, 1934, his blood pressure was 184/130 The heart was slightly enlarged to the left but was regular B M R was minus 13 Blood count showed H B, 90, R B C, 4,920,000, W B C, 7,100, lymphocytes, 25 per cent, polymorphonuclears, 75 per cent Blood chemistry showed N P N, 26.3, uric acid, 3.1, calcium, 7.2, and sugar, 91.7 Urine was entirely negative, specific gravity, 1.022, no sugar, albumen, or casts The glucose tolerance test showed fasting sugar, 91.7, $\frac{1}{2}$ hr after 100 grams of glucose, 122.8, $1\frac{1}{2}$ hrs

TABLE I

Sex	Age	Blood pressure before	No of treatments	Blood pressure afterward	Remarks
M	41	190/125	7	150/98	Headache relieved, strength and endurance improved
M	53	210/120	5	140/90	Marked improvement, returned to duty after being laid off 1 yr because of high blood pressure
M	58	210/150	9	158/120	Headache and vertigo relieved, vision improved
M	69	190/150		145/90	Headache and dyspnea relieved
M	52	230/130	12	178/92	Headache and precordial distress relieved, more strength and endurance
F	53	190/110	4	140/80	Headache and choking spells relieved
F	55	230/130	5	165/88	Precordial distress, headache, and dyspnea relieved
M	40	184/130	6	150/110	More endurance, less precordial distress
F	51	170/105	3	130/80	More endurance, no precordial pain no shortness of breath and feels fine
M	67	225/140	5	155/110	Headache disappeared, no vertigo
M	53	190/100	2	150/80	Is more relaxed and clear-headed has more endurance, precordial distress relieved
F	46	170/100	4	135/90	Feels better, sleeps better and is less nervous and irritable

after glucose 161, and $2\frac{1}{2}$ hrs after glucose, 109.8. After three treatments his blood pressure dropped to 165/120. He reported less precordial distress and more endurance, and a peculiar ashy gray color had been replaced by a normal appearance. Nov. 9, 1934, his blood pressure was 158/108.

In Table I are presented a few cases chosen more or less at random to illustrate the varied response to this form of therapeutic effort.

In some instances patients have been regarded as unimproved but were later found to have experienced a satisfactory reduction in blood pressure without further treatment. An example of this is Mrs. E., aged 52 years, who came under observation in November, 1931. She complained of hot flashes and "rheumatism" of her knees and legs. She said she had slowed down both mentally and physically and had gained 20 pounds in weight in the preceding year. Her B. M. R. was reported as minus 20. She was 5 ft. 9.5 in. in height and weighed 204.5 pounds. Her blood pressure was 165/108. Under treatment she lost weight slowly so that by June, 1932, she weighed 170.5 pounds, her blood pressure was 170/90. In January, 1933, her blood pressure was 178/100. In November, 1933, her weight was 179.5 pounds, and her blood pressure 160/95.

weight was 183.5 pounds. She had no further treatment. On July 26, 1934, her weight was 183.5 pounds, her blood pressure 145/86. Her hot flashes, of which she had complained rather bitterly, were much less troublesome and she stated that generally she felt very well.

We have seen 12 cases of co-existing diabetes mellitus and hypertension, out of which number, nine were men and three were women. Five were greatly improved or completely relieved of both conditions, that is, the glycosuria disappeared and blood sugar was reduced to normal. The blood pressures were as follows:

Before treatment	After treatment	Patient's age	Patient's sex
200/160	150/80	63	F
215/80	138/65	27	M
252/145	140/80	54	M
200/105	140/85	68	M
170/100	150/90	67	F

In two cases only the hypertension was relieved, the diabetes was not materially affected.

Before treatment	After treatment	Patient's age	Patient's sex
160/90	140/80	46	M
195/100	160/90	84	F

In one case the carbohydrate tolerance was improved and the subjective symptoms of vertigo, headache, and weakness almost entirely disappeared, while the blood pressure was reduced but little. One case experienced a reduction of 70 points on the systolic and 60 on the diastolic.

First Technic

	K V	Port	Filter	ST D	Ma	Time	M.A M
Pit	110	10 × 10 cm	1 mm Al 0.25 mm Cu	50 cm	4	20 min	80
Adr	Same dosage in every respect						

Second Technic

	K V	Port	Filter	ST D	Ma	Time	M.A M	r units
Pit	110	10 × 10 cm	2 mm Al	50 cm	4	7 min	28	51.8
Adr	110	20 × 20 cm	2 mm Al	50 cm	4	7 min	28	51.8

Third Technic

	K V	Port	Filter	ST D	Ma	Time	M.A M	r units
Pit	120	10 × 10 cm	2 mm Al	50 cm	5	8 min	40	106.4
Adr	120	15 × 15 cm	2 mm Al	50 cm	5	10 min	50	133

She was given x-ray treatment to the adrenals and pituitary. This treatment was repeated Dec. 14, 1933, and Feb. 8, 1934. At which time her blood pressure was 168/95, B. M. R. minus 20, and her

tolic, improvement in her diabetes did not occur until several months later. One case had only one treatment.

Technic—Our first consideration was to be sure that no harm was done the patient

by the treatment. Consequently we began with very small doses, the factors being as shown on page 336

Later, having had the feeling that if still heavier doses were given the results might be obtained more promptly and would be generally improved, we set up the following three sets

10 × 10 cm fields to the pituitary from each side

10 × 15 cm posterior field to the adrenals

Six hundred r units were administered to the pituitary from each side and 600 r units to the adrenals by the posterior field

				Light					
	K V	Port	Filter	S T D	Ma	Time	M A M	r units	
Pit	130	10 × 10 cm	2 mm Al	50 cm	5	10 min	50	65	
Adr	130	15 × 15 cm	2 mm Al	50 cm	5	10 min	50	65	
				Medium					
	K V	Port	Filter	S T D	Ma	Time	M A M	r units	
Pit	180	10 × 10 cm	0.25 mm Cu	50 cm	5	10 min	50	95	
Adr	180	15 × 15 cm	1 mm Al	50 cm	5	10 min	50	95	
				Heavy					
	K V	Port	Filter	S T D	Ma	Time	M A M	r units	
Pit	180	10 × 10 cm	1 mm Al	50 cm	5	15 min	75	142.5	
Adr	180	15 × 15 cm	0.25 mm Cu	50 cm	5	20 min	100	190	

However, after using the higher dosage in a few cases, we came to the conclusion that not only were our results not improved but they were definitely not so good as those obtained with the lighter doses. Patients experienced some unpleasant reactions in the shape of headaches, dizziness, and occasionally nausea, many claiming that they did not feel quite as well for a week after treatment as they did before. Furthermore, there was no commensurate reduction in blood pressure, either in degree or in the promptness in which it came about. We have a feeling, which is by no means supported by adequate evidence, that the heavier treatment tends in some way to fix the blood pressure at the level it was when the treatment was given. The experience of other men who have used very much heavier doses than we have ever done tends to strengthen our belief that the smaller doses are preferable.

We have recently been informed (29) that the following factors have been used in another institution

200 K V P, valve-tube rectification
6 ma
50 cm distance
0.5 mm copper and 4 mm celluloid filtration

in daily doses of 300 r, the pituitary being treated first and then several weeks later the adrenals. No reduction in blood pressure is said to have followed this treatment.

On the other hand, a letter from a physician tells us that he had administered to his own adrenals the following treatment

Aperture 9 × 15 cm (single aperture for both adrenals)
Target 50 cm skin distance
Filter Copper, 0.75 mm
Aluminum, 1 mm
Adrenal at 7.5 cm
Dose 30 per cent of 814 r units at the adrenal

The above was given in two half hourly treatments on successive days. This was said to have been followed by relief of most of the subjective symptoms, particularly headache, with considerable reduction in blood pressure.

On the other hand, Hubeny (29) used the following factors in the treatment of a case to which he gave three treatments

Kilovolts, 115
Skin target distance, 25 cm
Filter, 4 mm aluminum
Milhamperes, 5

Time 8 minutes to each side of the
pituitary
18 minutes to the adrenals
Pituitary and adrenals treated at one
sitting

The blood pressure continued to decline for several months after treatment was stopped and reached entirely normal levels

However, it is probably true that this treatment cannot ever be absolutely standardized. In dealing with human beings, the infinite variety every doctor comes to know must always be taken into account and it is our effort to adapt the treatment to the individual after determining his idiosyncrasies rather than to subject him to a pre-conceived idea of what he needs. The variations in roentgen-ray machinery and similar factors must also be considered. The foregoing technical data must therefore be accepted in the light of this need.

Before treatment is instituted, the patient should be given the benefit of a very searching physical examination, in which the state of the kidneys should be carefully investigated. While he is under treatment, he should be carefully supervised, the blood pressure should be taken at least once a week, and the urine should be examined before each treatment.

In our examination a 24-hour specimen of urine is examined. The blood sugar, NPN, uric acid and calcium are determined. A phenolsulphonephthalein test is run. We frequently do a BMR and glucose tolerance. The vast majority of patients with essential hypertension exhibit a diabetic type of sugar curve after the ingestion of 100 grams of glucose (O'Hare (30) suggested many years ago that this test might be used to separate the nephritic from the essential type of hypertension. Those exhibiting the diabetic type of sugar curve, he believed, belonged to the essential variety.)

We have done 47 glucose tolerance tests on 45 patients. Thirty-one of these had a rise of blood sugar to above 170 mg, 21 having a rise to more than 200 mg of blood sugar and one man had a rise to

333 mg. We do not know what effect treatment has on the glucose tolerance, as we have been able to repeat the test after treatment in only two cases. In both, however, the blood sugar curve was more nearly normal after irradiation.

Cushing (9) noted some osteoporosis in his cases of pituitary basophilism. We thought that perhaps the pituitary activity might be reflected in the parathyroids. However, blood calcium is practically always on the low side of normal. As a matter of fact, readings below 8 mg per 100 cc of blood are much commoner than those above 9 mg.

The BMR varies from normal about as often in one direction as the other, however, we have not followed this in enough cases to correlate with response to the irradiation. In those cases that have been followed, the BMR has usually shown a decline, having fallen in one instance from plus 48 to minus 6, in another from plus 10 to minus 6.

It is our belief that Stieglitz (31) is correct in assuming that essential hypertension is first a paroxysmal affair, the rise being due to spasm of the vessels. Later this spasm becomes constant and the tension remains well above normal. This is followed by changes in the vessel walls which are irreversible and fix the pressure more or less permanently at a high point. We believe that the amyl nitrite test furnishes some idea as to that portion of the abnormal blood pressure which is due to spasm. Consequently of late we test every patient to see how much reduction in pressure can be brought about by the inhalation of amyl nitrite. The reduction in blood pressure effected by that means gives us some idea of how much reduction may be expected as the result of irradiation.

Some patients vomit after irradiation, we do not know why this occurs, but have made it a rule not to continue treatment in these cases. We persisted in one or two of these cases at first, but found that they were not being materially benefited and since then have abandoned the irradiation therapy when vomiting occurs.

It is my impression that hypertension occurring in persons of slight build is rather more resistant to treatment and offers a poorer prognosis than that occurring in taller persons and those of a heavier build. This, however, is an impression rather than an established fact.

The skin shows a rather pronounced reaction to these treatments, it tends to become smoother, softer, and more moist. The quality of the nails improves. In at least one instance there has been a rather considerable loss of excess hair on the thighs, which could not be called a case of hirsutism, but the thighs were covered with a rather heavy growth of coarse black hair which extended to the groin. After a few treatments this almost entirely disappeared and the skin which had been abnormally rough became quite smooth and moist. Another patient had a severe generalized psoriasis, the scaling being very troublesome. After the first treatment these scales almost entirely disappeared, the lesions appeared to be more active but none of them have disappeared.

The menstrual periods, if irregular, tend to become regular and the periods more normal as to duration and quantity.

The blood pressure is not always reduced by this treatment. We have a number of diabetics to whom the same factors of treatment have been given without any change in blood pressure but with considerable increase in carbohydrate tolerance. Data at this time tend to support the belief that diabetics will do better on smaller doses of roentgen-ray than are necessary to correct essential hypertension.

Patients coming from families in which many members are victims of hypertension appear to respond favorably to this method of treatment.

We have had a few cases which had a fair amount of treatment with but little improvement. A few others showed a satisfactory response at first, but later the blood pressure rose almost to the original level. One case has shown no response at all. We do not know the reason for these failures.

Undoubtedly the age of the patient and the duration of the hypertension have much to do with the prognosis. The younger the patient, the shorter the duration of his hypertension, the better the outlook. That probably explains why patients coming from our out-patient department have done better than patients in the hospital.

It will be noted that this discussion is concerned with the treatment of essential hypertension, consequently, we did not expect to treat any nephritics with hypertension. However, other men have sent in a few nephritics who have had this treatment, some of which have experienced some symptomatic improvement and reduction in blood pressure. Goldzieher's (16-b) idea regarding the relation of hypertension to nephritis is probably correct in many cases. Such patients might show considerable improvement as a result of this treatment, but certainly it cannot be expected to relieve nephritis. No marked relief should be expected in cases of marked arteriosclerosis, although where the pressure is abnormally high and there is fear of a rupture of some vessel, this treatment might be used to effect reduction in pressure to a safer level. A man 79 years of age and a woman 84, both suffering with general arteriosclerosis, were definitely better following this treatment. In cases in which the sclerosis is pronounced, we believe the patient to be undoubtedly better off if the pressure remains well above the theoretical normal and we do not attempt to reduce it much. Hypertensive heart disease is not a contra-indication and, as a matter of fact, its victims should improve following this treatment. Angina pectoris at this time cannot be regarded as a contra-indication and there is some reason for believing that the attacks may be lessened in frequency and severity by irradiation.

SUMMARY

A previously suggested theory as to the etiology of essential hypertension is expanded and modernized in the light of re-

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18 minutes to the adrenals
Pituitary and adrenals treated at one
sitting

The blood pressure continued to decline for several months after treatment was stopped and reached entirely normal levels

However, it is probably true that this treatment cannot ever be absolutely standardized. In dealing with human beings, the infinite variety every doctor comes to know must always be taken into account and it is our effort to adapt the treatment to the individual after determining his idiosyncrasies rather than to subject him to a pre-conceived idea of what he needs. The variations in roentgen-ray machinery and similar factors must also be considered. The foregoing technical data must therefore be accepted in the light of this need.

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In our examination a 24-hour specimen of urine is examined. The blood sugar, N P N, uric acid and calcium are determined. A phenolsulphonaphthalein test is run. We frequently do a B M R and glucose tolerance. The vast majority of patients with essential hypertension exhibit a diabetic type of sugar curve after the ingestion of 100 grams of glucose (O'Hare (30) suggested many years ago that this test might be used to separate the nephritic from the essential type of hypertension. Those exhibiting the diabetic type of sugar curve, he believed, belonged to the essential variety.)

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DISCUSSION OF SYMPOSIUM ON DUCTLESS GLANDS

DR HUTTON (Chicago) Naturally I feel flattered at the compliment of being invited to appear before this group, at the same time, I feel considerable timidity in venturing to discuss a form of therapy in which you are the foremost experts in the world. The only hope I have of "getting by" with it is to adopt the tactics accredited to Gladstone, who was something of a Greek scholar as well as a lawyer. In the presence of lawyers he discussed Greek, and in the presence of Greek scholars he discussed law.

So hoping that you may be somewhat guilty of the fault charged to all specialists—that of limiting yourselves too much to your own specialty—perhaps if I talk about the clinical and internists' side of this we shall get along.

DR M J HUBENY (Chicago) First, I want to make an acknowledgment that I don't know very much about this. On the other hand, I want to express my gratitude for being given the opportunity to work with Dr Hutton, because there are several things in common between the endocrines and radiant energy. That is, their subtle action and the necessity for the most careful application of these particular remedial measures.

Dr Hutton has given you the symptomatic conditions, the close observation of the patient, and has given you a variety of techniques.

The thing that has impressed me in practically all these papers—and I was very glad that Dr Perry brought out the thing he did—is, that in spite of the variable methods of treatment, we have a high degree of uniformity in our end-results.

I am not going to say very much about the symptomatic side of it because Dr Hutton knows so much more about it, and,

as I said before, he does this so thoroughly and so well and with such a great amount of care, realizing that these things are so finely balanced, with improper attention, one can create a much greater imbalance along certain directions than the original disease for which one is treating the patients.

I have been impressed with some of the good end-results and the relatively small doses necessary to produce those results. One of the low voltage techniques is something like this: portals about 6 centimeters square, about 16-inch skin-focal distance, 115 K V, 5 ma, filter of 4 mm of aluminum, time approximately 8 minutes, which is equivalent to 13.2 r per minute, which gives a total dose of 105.6 r. With these factors, the erythema dose runs to about 400 r.

Just before coming to this assembly, I overheard a discussion in which it was stated that a group of factors in which the voltage was low and produced a certain number of r could be transposed into a formula in which the voltage was higher, the filtration heavier, and the number of r the same as before. This may be true as to the number of r, but it is not true as to the amount of r necessary to produce an erythema, in the lower voltage with less filtration it will take less r to produce an erythema than the formula in which the voltage is higher and filtration is heavier. That brings us back to the old question of the amount of radiation absorbed by the tissues, and this is exceedingly important, it is the biological-chemical effect that is important. I am convinced that we have an additional effect on cells which is undesirable, namely, a mechanical disturbance, such as physical displacements of the cells and their structures, and that this tends to be present in an increasing amount as voltages go up. I am also convinced that the cells have an affinity for a certain amount of radiation, which might be designated as "sensible absorption," and that the lower voltages with relatively small filtration and less homogeneity of the rays, contain sufficient varieties of wave lengths to give the

cent experience in endocrinology. This theory is That the pituitary body and adrenals, by some spontaneous dysfunction, probably a hyperfunction, set up the abnormal arterial tension.

The evidence supporting the claim of pituitary influence on the adrenals and of direct hypophyseal influence on blood pressure and the claim of adrenal influence on blood pressure is summarized briefly.

A hypothesis that this hyperfunction may be due to withdrawal of the gonadal hormonal factor controlling pituitary activity is set forth, with brief summation of the data supporting it.

The results of attempts to reduce this theorized pituitary-adrenal over-activity by means of roentgen irradiation are described as follows. 96 of 123 patients were definitely improved, including in most cases a reduction of the sphygmomanometer reading and in all cases relief of the distressing associated symptoms. The responses of various symptoms to the treatment are described.

Several typical case histories are presented.

This theory is also applicable to diabetes mellitus, and some notes on a few cases of diabetes and of diabetes plus hypertension are given.

The radiological data are presented.

Sundry notes and observations are included as to the handling of these patients, prognosis, complications such as nephritis, angina pectoris, arteriosclerosis, etc., and the need for careful individualized supervision of these cases is emphasized.

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causing hypoglycemia at that time, because he remained well for six and one-half years following the removal of the thoracic tumor and there was no treatment of the pancreas at that time

We might suspect that he now has a metastasis to the pancreas, since the original tumor that was removed was malignant, however, metastases to the pancreas are not common. Also, this man had previously recovered from a similar attack following the removal of a thoracic tumor. I believe that we are justified in assuming that the hypoglycemia in 1927 was due to the presence of the thoracic tumor and that the hypoglycemia is again due to the presence of the large newgrowth which he now has

It is said that bronchogenic tumors may produce an insulinoid substance, and it would appear that such is the case here, and that we are dealing with a case of hyperinsulinism of that type. Concluding that we were dealing with a recurrence of the fibrosarcoma, which was large and not amenable to surgery, and suspecting that the pancreas might also be involved, roentgen therapy was given. Small doses caused anorexia, nausea, and vomiting. However, he received 2,000 r in divided doses to the left side of the thorax and over the pancreas. Some benefit was received as was evidenced by the fact that he was able to go three hours between feedings instead of one and one-half hours as before. Last week [November, 1934], this man developed a rather sudden abdominal distention and died a few hours later.

At autopsy an incarcerated right inguinal hernia was found. The left side of the chest was completely filled with numerous tumor masses of various sizes, fibrous in character, evidently a recurrence of the fibrosarcoma. There was no evidence of gross lesion of the pancreas, adrenals, or of any other organ. Since no lesion of these organs was found, we must conclude that this was a case of hyperinsulinism due to secretion of insulinoid substance in a bronchogenic tumor. The hyperinsulinism was relieved on removal of the tumor seven

years ago, reappearing again on recurrence of the tumor six and one-half years later. Further evidence is seen from the fact that x-ray therapy, which retarded the growth of the tumor somewhat, had a beneficial effect on the time of recurrence of symptoms of hypoglycemia.

DR CHARLES F BAKER (Newark, N J) Dr Hubeny has asked me to tell of our experience with a few cases. We treated two series of ten each. One series received 100 r over each side of the skull and over the adrenal glands. In treating the adrenals we used a large cone directed in the mid-line and including both kidney areas. The second series received 100 r to one carotid sinus. We seemed to get about equal benefit with either method—about 50 per cent were improved. We seemed, however, to feel that better results were obtained in those patients in which the treatments were given over the pituitary and adrenal glands.

DR BARROW (closing) I do not know that I have anything to say further than to report that the two cases which I had not time to present were, one, practically a duplicate of that I did present, and the other, a case of what is ordinarily termed epilepsy.

I do not know but that, in giving these doses supposedly to the pancreas, I am giving what is sometimes spoken of as a "stimulative dose" to the adrenals. Possibly so, I do not know.

The cases are reported simply because of the fact that for over a year we have had a symptomatic cure without any alterations in treatment otherwise.

DR PERRY (closing) Dr Hubeny has asked about our technic. We use 200 K V, 25 ma, and a filter of 1 mm of copper plus 1 mm of aluminum. We are convinced that there is no specific relationship between wave length and biologic effect, and prefer this relatively high voltage and heavy filtration simply because it allows a rather uniform irradiation of the whole

cells an opportunity of selecting a suitable affinity. Cells are or are not susceptible to x-rays and if not, no method is at present available to make them so. It is almost axiomatic that in diseases in which the x-rays are of proved value, it is not necessary to produce an intentional erythema.

Certain of these cases have produced some interesting phenomena. One case exhibited a temporary alopecia over the treated pituitary areas, not due to the amount of the x-ray. It is well known that hair growth is influenced by the pituitary gland and it is possible that the joint effect of the x-rays on the gland and the skin caused the alopecia.

The possible complexities can be comprehended when it is understood that most physiologists are agreed that the pituitary gland has eight hormones, and that each one has three functions. It is calculated that, because of this, over six thousand combinations are possible. It is impossible to make biopsy studies of the sella, consequently all our conclusions will have to be made on the physiologic end-results. Little reliance can be placed upon the size of the sella—I mean, as far as physiologic disturbance is concerned. Of course, this remark does not refer to those that are definitely enlarged, but only to normals or borderline sizes and contours.

In some of these cases I included the carotid plexus, however, only time will tell us as to the effectiveness and limitations of this method of treatment. No doubt, many of you will come to the meeting next year, extolling its virtues or condemning some of its features, based on your personal experiences and observations, however, it is hoped that many of these cases will come to you before they have been long existent.

Dr. Barrow's paper was very interesting. I have had no similar cases. However, I did treat a patient's head, hoping it might favorably influence attacks of grand mal, and he came in six weeks later with a wonderful crop of boils on which I am now having some blood chemistry tests done. He had a somewhat similar spontaneous attack about sixteen years ago.

DR. R. P. POTTER (Marshfield, Wis.) I wish to congratulate Dr. Barrow on the excellent paper he has presented on the subject of hyperinsulinism, and on the results he has obtained from roentgen therapy. It will be interesting to follow these cases and to observe if they remain well over a period of years.

I have not treated any cases in children or young adults, but should like to report a case of hyperinsulinism in a man over 60 years of age.

At the Radiological Society meeting in Chicago in 1928 I read a paper on intra-thoracic tumors, citing a case of a man aged 62, on whom we operated, removing a four and one-half pound fibrosarcoma from the left thoracic cavity in November, 1927. Previous to the operation the man had had attacks of mental confusion and delirium which, I believe, were due to hypoglycemia, but the condition was not recognized as such at that time. Following the removal of the tumor the man made an uneventful recovery, did not have any further attacks of mental confusion, and remained entirely well for six and one-half years, when he again developed attacks of mental confusion, exhaustion, and delirium of serious proportions. These conditions were immediately relieved by intravenous glucose, but he continued to require food or glucose at one and one-half hour intervals. The blood sugar was found to vary from 70 to 30 mg. On giving sugar tolerance tests the blood sugar would rise to 215 mg., and rapidly go down to as low as 30 mg.

X-ray studies of the chest revealed that the left side, which had remained clear for several years, was now nearly filled with a dense mass. Re-examination of the chest at intervals showed the density increasing, until the left side was entirely filled. Suspecting a lesion of the pancreas, adrenals, or pituitary, adrenalin and pituitrin were given when the blood sugar curve was going down, but neither had any effect. A thorough neurologic study failed to point to a lesion in the brain.

We cannot conclude that this man had a tumor of the pancreas seven years ago,

BILIARY COLIC FISTULA¹

By H B PODLASKY, M D , Milwaukee, Wis

HOPE I am not presumptuous in assuming that I am the second observer to report a case of this type. In this statement I am borne out somewhat by a personal communication from Dr Firor, associated with Dr Waters, who made a thorough

A case of biliary colic fistula is reported because of the fact that it presents a condition which is rarely diagnosed by roentgen methods before operation. In the roentgen literature there appears only one other reference, namely, that of Judd and Bur-

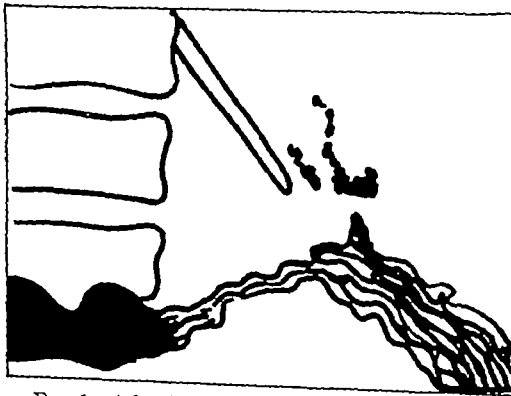
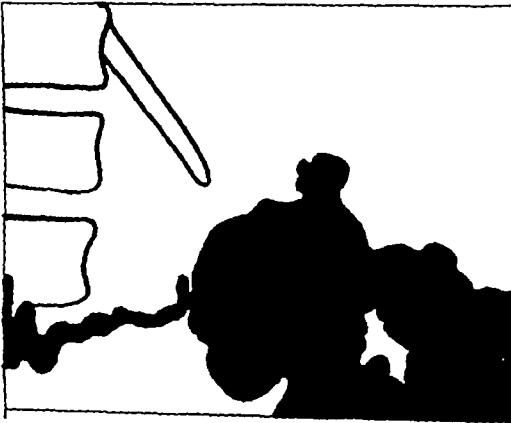


Fig 1 (above) Six-hour film, ingested barium showing in gall bladder continuous with hepatic flexure (Aug 24, 1932) (Diagram from which slide was made)

Fig 2 (below) After evacuation of barium enema hepatic flexure of the colon is shown with barium lining the mucosa. Immediately above the colon is barium shadow in the gall bladder (Aug 27, 1932) (Diagram from which slide was made)

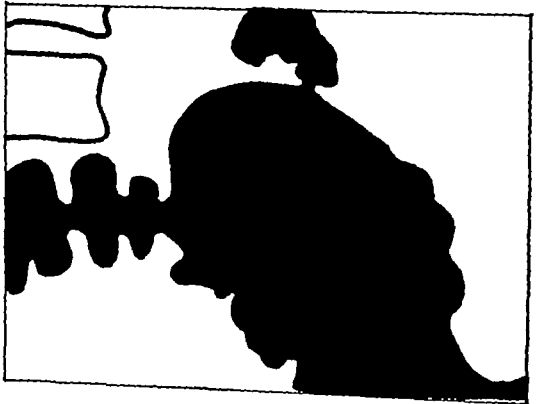
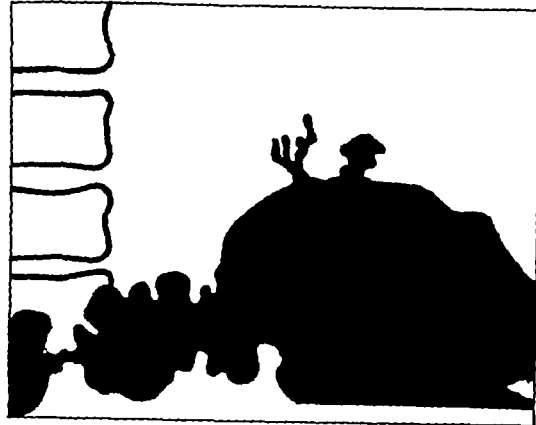


Fig 3 (above) Barium enema filling hepatic flexure of colon and partially filling adjacent gall bladder in an irregular manner (Aug 27 1932) (Diagram from which slide was made)

Fig 4 (below) Fairly large amount of barium escaping from a well-filled hepatic flexure (Aug 29 1932)

search of the literature up to 1933, and who recently stated that since that time he has not found a similar case reported

den, in 1925, calling attention to four cases of this type diagnosed by the roentgen ray

The case here reported will perhaps prove of interest not only on account of the possibility that it may be the fifth case reported by a second observer after

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis Tenn Dec 3-7, 1935

area under treatment. As we see it, the only possible advantage of a less penetrating beam would be the sparing of normal tissue beneath the thyroid, because we hold, with Landauer, that there is no such thing as shooting through tissue nearer the surface without affecting it.

The question has been raised as to the

dependability of the surgical statistics I have quoted. I believe that the very mass of them makes them dependable. There is unevenness, of course, and one must use discretion, but most of us know which surgical writers to turn to for statistics of this sort.

Past History—Pain in the right hypochondrium about fifteen years ago which lasted about two months, treated then by Dr G W Nelson. No history of other illnesses.

Family History—Father and mother died of old age, five brothers are living and well, two sisters are living and well. There is no family history of carcinoma or tuberculosis.

Examination (by Systems)—C N S Headaches when seized with pain in right upper quadrant. C R S No cough, dyspnea, palpitation, or precordial pain. G I S Appetite fair, constipated for years, uses mineral oil and some "cathartic pills", no melena, jaundice, or diarrhea. G U S No dysuria, frequency, or burning. Catamenia Climacteric fourteen years ago, menses regular previously, no bleeding, spotting, or discharge since menopause.

Social History—Age 60 years, housewife, seven pregnancies (five children living and well, one child died at two years, one miscarriage).

Physical Examination—General Well developed, cachectic old woman. Head Eyes—Pupils react to light and accommodation. Ears and nose—No discharge. Mouth—Plates, no congestion, tongue not coated, pharynx clean. Neck No adenopathy, thyroid not felt. Chest Lungs—Resonant, breath sounds clear, few crepitant râles posteriorly at bases. Heart—No enlargement or arrhythmia, no murmurs, blood pressure, 148/98. Abdomen Soft tissue turgor lost, no palpable masses, no tenderness in epigastrium or gall-bladder region. Extremities No varicosities, no edema. Reflexes Normal.

Laboratory Examination (Sept 26, 1933)—Red blood count, 3,080,000, hemoglobin, 49.2 per cent, color index, 0.8 per cent, leukocytes, 7,000, polymorphonuclears, 72 per cent, lymphocytes, 26 per cent, monocytes, 2 per cent.

Urine Specific gravity, 1.018, reaction, acid, albumen, trace, sugar, 0, blood, few red blood cells, cells, 18–20.

Sedimentation rate Start, 100 per cent,



Fig 8 (above) Gas outlines of narrow tracts immediately adjacent to colon (Sept 29, 1933) (Diagram from which slide was made)

Fig 9 (below) Colon enema, made during the third examination showing gas and barium immediately adjacent to hepatic flexure (Sept 29, 1933)

15 min, 88 per cent, 30 min, 78 per cent, 60 min, 56 per cent, 120 min, 41 per cent, 24 hrs, 30 per cent

Gastric Analysis (Sept 27, 1933)—

	Free HCl	Total Acid	Lactic	Blood
15 min after histamine	0°	Unable	0°	+
30 " "	0°	because	0°	+
45 " "	10°	bloody	0°	+

Microscopic Epithelial cells, 6–8 leukocytes, 25–30 red blood cells, fat droplets.

Feces (Sept 28, 1933)—Blood, strongly positive.

Blood Cholesterol Test showed 164.8 mg on Sept 26, 1933.

Icteric Index Was 5.4

The patient was put at bed rest on ad-

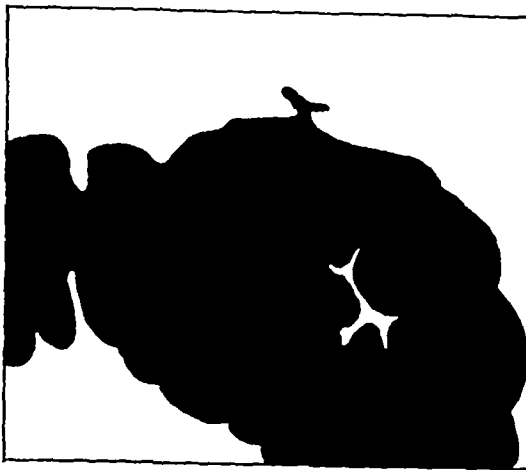


Fig 5 Distended hepatic flexure with a very slight escape of barium into gall bladder (Dec 28, 1932)

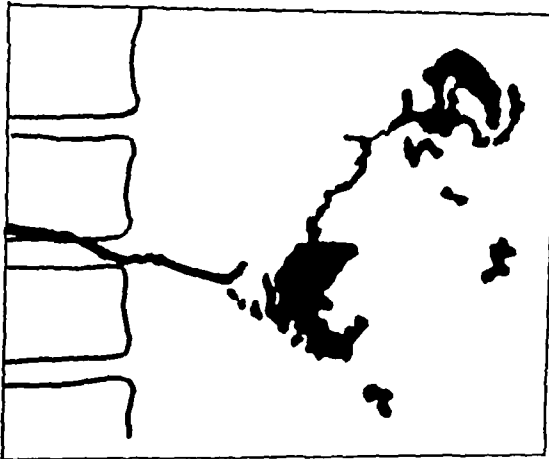


Fig 6 Six hour film Hepatic flexure almost empty, barium escaping into gall bladder (Dec 28 1932) (Diagram from which slide was made)

At times both gas and varying amounts of barium may be noted in the filling defect

Biliary colic fistula should not be confused with the much more commonly visualized biliary duodenal fistula, of which there have been 36 cases reported. A case of this type, namely, biliary duodenal fistula, is also shown to bring out the marked difference in roentgen manifestations. The accompanying illustrations will serve to demonstrate the variability of the roentgen manifestations :

CASE REPORT

The patient, Mrs M R, is a white female, aged 60, who entered the hospital on Sept 25, 1933, with complaints of

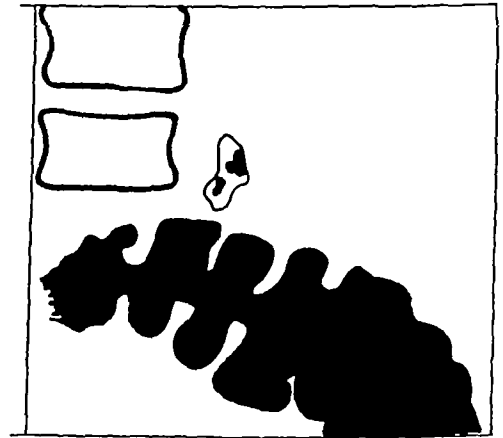


Fig 7 Six hour film made on third examination Gas and barium in gall bladder (Sept 29 1933) (Diagram from which slide was made)

was examined three times—twice in 1932 and once in 1933, just prior to operation. Each examination disclosed the fistulous tract both after the ingested meal and the barium enema series. It was also found on films after the barium enema had been evacuated.

It may be emphasized that in each examination the filling defect as noted immediately adjacent to the hepatic flexure was not duplicated in a single instance. The defect, if it may be so termed, manifested itself either as an air or gas channel or a small or large, very irregular pocket containing barium which had escaped from the colon into the adjacent gall bladder.

vomiting, pain between the shoulder blades, and loss of weight.

History of Present Illness—She has had attacks of pain and vomiting on and off for the past year. Vomiting relieves the pain. She also has dyspepsia following the ingestion of meat, fried food, and fats. Within the past year there has been a weight loss of 55 pounds, during which period she has been treated at the dispensary. The day before admission to the hospital she vomited and the pain became worse, this was followed by a fainting spell.

* I am indebted to Mr Leo Massopust of Marquette University for the preparation of the diagrams

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Fig 10 (above) A very slight amount of barium escaping from colon into gall bladder from barium enema (Sept 29 1933)

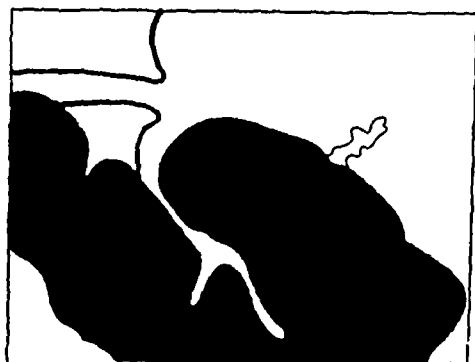


Fig 11 (below) Small irregular outline of gas immediately adjacent to colon. Barium enema outlining the colon (Sept 29, 1933)

mittance Temperature was 99, pulse, 98, respiration, 28

She was given supportive treatment consisting of two intravenous injections of 500 cc each of 1.8 per cent NaCl and 10 per cent glucose

On Oct 5, 1933, she was operated on. A fistulous tract was found between the hepatic flexure of the colon and the fundus of the gall bladder. The bowel was separated from the gall bladder and sutured. The gall bladder contained one large stone, which was removed. The stomach was found free and normal, as were the transverse colon and the liver. A cigarette drain was inserted.

On Oct 6, 1933, at 6:15 A.M., the patient became restless and irritable. It was impossible to get the pulse or blood pres-

sure. She complained of pain in the left calf and at 7:15 she was pronounced dead.

Pathologic Report—The gall bladder contains a small calculus. There is a small diverticulum of the fundus. The mucosa of the upper half is irregular and hyperplastic. Microscopic examination shows diffuse glandular hyperplasia of the mucosa, infiltration of the mucosa with lymphocytes. There is no evidence of malignancy. The mucosa is necrotic and ulcerated in places.

Diagnosis—Chronic interstitial cholecystitis, polypoid hyperplasia of the gall bladder, cholelithiasis.

Films and lantern slides of a case with a biliary duodenal fistula were shown in the exhibit at Memphis, in December, 1934.

INTERNAL BILIARY FISTULAS

Of the forty-odd cases reported in the roentgen literature, most of them have been biliary-duodenal fistulas. Only four cases have been reported in the roentgen literature of connection between the colon and gall bladder. The forty cases are classified as follows:

Hepato-bronchial fistulas,	2 cases
Gastro-biliary	1 case
Duodeno-biliary	36 cases
Biliary-colic	4 cases
(colon and gall bladder)	

Diagnosis is made by the presence of air or barium in the biliary tract. The formation of these fistulous connections usually depends upon the presence of a biliary calculus which has ulcerated through the gall bladder into the gastro-intestinal tract. Gastric and duodenal ulcers and carcinoma of the stomach are among the rarer causes. The only cases diagnosed by roentgen-ray visualizations are the four cases reported by Judd and Burden (Ann Surg, 1925, 81, 305).²

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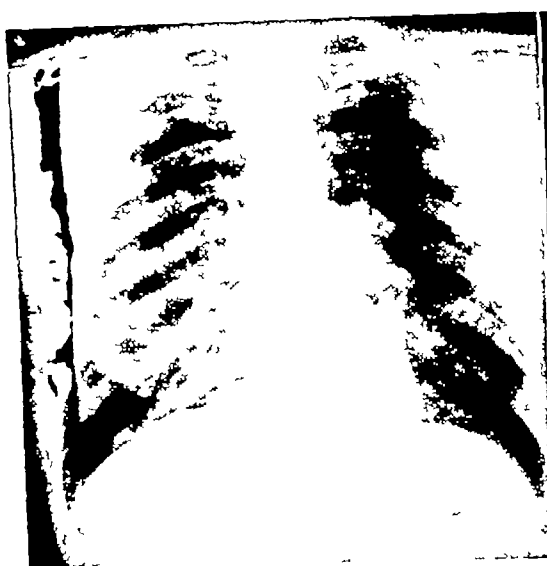


Fig 2 Artefact caused by leakage of λ rays in cassette storage box where lead protection had become displaced. Only the 14 X 17 inch films were affected, as the others did not reach this height

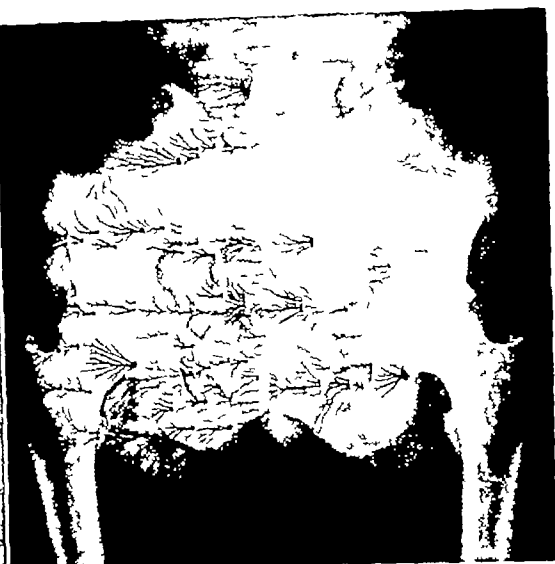


Fig 3 Static marks produced by jerking the film out of a tightly packed box

If a cassette is placed against a solid wall while a radiograph is being taken, there may be enough back-scattering to pass through the back of the cassette and thus show shadows of the supporting ribs

Fog due to λ -radiation or radium is approximately of equal density on both sides of the film. This can be tested by moistening a spot on each side of the film and scraping off the emulsion on that side. The densities of the two single coatings are then compared. If the fog is due to exposure to light, it is usually more pronounced on one side of the film than on the other.

If a package of films is accidentally exposed to x-rays the corrugations in the packing material will show up. On Eastman films, the shadow of the lead band placed in the box for this purpose becomes visible. Development of one of the films from the box without further exposure will reveal the fog.

II—STATIC ELECTRICITY

When the relative humidity¹ is below

¹ Relative humidity is defined as the weight of water actually present per unit volume of air divided by the weight of water that is necessary to saturate that volume at the existing temperature

about 20 per cent, it is very difficult to prevent static electrical discharges from leaving their marks on the film. The best way to prevent the generation of static electricity is to condition the air so that the relative humidity is at least 40 per cent. Where air conditioning equipment is not used this is impractical and it is necessary to avoid the generation and discharge of the electricity by other means.

Static electricity may be produced either in the body of the technician or locally in the film and cassette. The fact that walking on a carpet in a dry atmosphere will charge the body to a high potential (producing a small spark if a radiator or light switch is touched) is well known to almost everyone. The same thing can happen when walking on linoleum or cork floors. If the technician's body is highly charged and he touches a film, a spark will jump from his finger and make a mark on the film. The best way to prevent this is for the technician to touch a grounded metallic body before he touches the films in order to allow the charge to run off of his body. A convenient method is to have the bench, or at least the edge of the bench, covered with metal which is grounded.

ARTEFACTS IN ROENTGEN FILMS

By GEORGE C HENNY, M D , *Philadelphia*

Department of Roentgenology, Temple University School of Medicine

AN artefact in a roentgen film is a marking produced by an agent other than the x-ray through the part being radiographed. An artefact may be of any size or shape and may be either negative or positive in phase (may be exhibited as an area of film lighter than its surroundings—the negative phase—or darker than its surroundings—the positive phase)

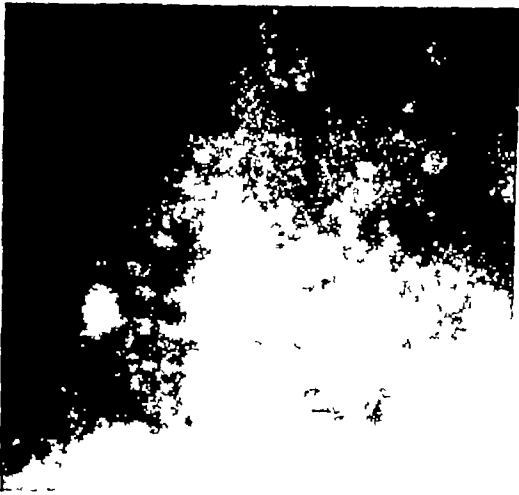


Fig 1 Film markings produced by excessive moisture and heat in the film storage room. In most places the emulsion is desensitized, but in one spot it is actually sensitized

Every roentgenologist occasionally sees artefacts in his films. They appear even in the most carefully controlled laboratories. Sometimes the cause is easily traced but at other times it is very puzzling. The roentgenologist is apt first to think that the artefacts were produced in the manufacture of the films and may even change his brand of films on that account. However, experience has shown that artefacts produced in the manufacture of present-day films are rare. A review of the causes of artefacts in roentgen films will aid the roentgenologist to trace his difficulty in any particular case.

It must be kept in mind that the emulsion of the roentgen film is a very sensitive

substance, easily affected by light, stray x or gamma rays, by mechanical manipulation, by gases and vapors (such as illuminating gas, hydrogen sulphide, ammonia, formalin vapor), and by other chemicals and by excessive moisture and heat (Fig 1). The storage room for films should be free from all of these.

The most usual causes of artefacts are listed below.

I — STRAY RADIATION

Variable marks on the film may be produced by stray radiation from a fluoroscope. In one instance, a fluoroscope twenty feet away from the radiographic room produced a series of parallel lines (multiple exposures of a metal bar as the fluoroscopic tube was moved) on the finished film. The fact that a fluoroscope can produce such marks is well recognized, but that it can do it at such distances may be overlooked. Any leakage from the x-ray therapy room must also be ruled out. This is best done by trial exposures, for even though the tube is "auto-protected," conditions may be such that stray radiation is reaching the radiographic or loading room.

If there are a number of radiographic rooms and a film is being carried from one of these to the dark room while an exposure is being made in another, stray radiation may strike the film being carried. Exposed and unexposed films must, of course, be adequately protected in the radiographic room. In one instance, nails which held down the lead covering of the cassette storage box had worked loose and came out. The lead was bent down somewhat, and when x-rays from the radiographic table fell on the box, there was enough leakage to produce an irregular blackening of the films with three black marks corresponding to the nail holes (Fig 2). Radiation from radium or radon needles can produce marks on the films, but this is not apt to occur

might be due to static electricity, but their appearance was much different from the ordinary branched marks. Furthermore, all ordinary precautions were taken to prevent the production of static electricity. Investigation revealed that the dark room technician had started to wear rubber gloves to protect her hands from the solutions. She dried her fingers well before handling the films so the spots were not due to solution getting on the film. The artefacts which we were observing were produced when her gloved finger was lightly rubbed across the film; apparently the marks were of electrical origin. That conditions were favorable for the generation of static electricity was shown by the fact that there were typical branched static marks at the bottom of the film not shown in cut. When the gloves were removed, no more artefacts appeared. The spots in the central areas of the 14 × 17 inch films were at first misleading, because, naturally, one does not pick up such a film at its center. The films, however, were brought to the dark room in a film carrier. In picking up a 5 × 7 or an 8 × 10 inch film which is lying on a 14 × 17 inch film, it is very easy to touch the central area of the latter.

III—MECHANICAL INJURY

Film emulsion is quite susceptible to mechanical injury. The crescent marks (Fig. 6) sometimes seen on films are produced by bending or crimping the film as it is slipped into or removed from the cassette. Such marks can be reproduced at will. If a film is slid over a rough surface before development, dark irregular or sharp black abrasion marks may result. In rare cases artefacts are produced by pointed objects (such as might occur on the side of an old developing tank which has become roughened). These points puncture the thin emulsion protective coat, allowing developer to enter here before it does to the rest of the emulsion. The result is that over-development takes place at these points. The darkened spots are usually not circular.

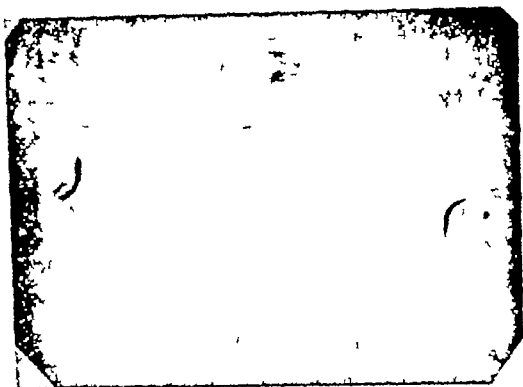


Fig. 6 Crescent-shaped markings result from crimping the film as it is picked up and slid into a cassette. The muddy marks at the top of the illustration were produced by touching the film with fingers wet with developer as it was being put into the hanger.

Melting of gelatin emulsion due to high temperature might also be placed under this heading. This is most frequently caused by holding the wet film against the illuminator. It might also be produced by hot water flowing through the washing compartment. Films are more easily injured from high temperature if they have been run through an exhausted fixing bath or one that was made without hardener. Reticulation—a puckered or net-like appearance of the film surfaces—results from excessive swelling of the gelatin in an uneven way and is brought about by sudden changes in temperature, such as removal of the film from a cool fixing bath to very warm wash water or *vice versa*.

IV—CHEMICAL EFFECTS

(A) Marks produced by touching the undeveloped film with fingers contaminated with dark room solutions may be dark or light. If due to developer on the film, they will be dark (Fig. 6), if due to fixing solution, they will be light. Developer marks can usually be seen by reflected light on the surface of the finished film. Spattering the films with these solutions will have the same effect. Chemicals on the dark room bench may also get on the films.

(B) A film placed in a cassette that has recently been cleaned with hydrogen peroxide will be fogged.



Fig 4



Fig 5

Fig 4 A line of static marks produced by jerking the paper off the film

Fig 5 Static electricity marks resulting from handling the films with rubber gloves. By stroking the glove-covered finger across an undeveloped film a series of dots, as shown at the top of the illustration, could be produced. That conditions were favorable for the production of static electricity is shown by the presence of the typical branched markings at the bottom of the film.

Static electricity may be generated locally on the film or in the cassette in a number of ways. It is usually done by jerking the paper and film out of a full box, by jerking the film from the black paper and placing it quickly in the cassette, by shuffling the film in the cassette, and by opening the cassette quickly (after the exposure has been made) and touching it either with the fingers or to any electrically conducting body. The following are precautions (when air conditioning is not possible) to prevent the generation of static. Do not pack films from the old box in with six dozen in the new box, remove the film from the box, and the paper from the film slowly, do not shuffle the film to center it in the cassette, open the cassette slowly, touch a grounded metallic object before touching the films.

Static marks take one of three forms (a) bush or tree-like markings—that is, branched, (b) small nearly round spots, (c) mottled or wool-like spots.

Jerking the film from the paper usually produces the typical tree-like markings; these are quite irregular, although they may appear in rows (Fig 3) or lines (Fig

4). Such markings may occur in the manufacture of the film, but it should be remembered that this is rare because the manufacturer is always on the lookout for them and operates under carefully controlled conditions of temperature and humidity. Markings produced in the manufacture of the film are apt to be regularly placed and in the same position on successive films, as along one edge, for instance.

When static marks are not of the typical tree-like variety they may be difficult to recognize. (Magnification of small spots frequently reveals their true nature.) If a film placed in a cassette is moved around with the fingers, static marks are liable to be produced. These marks will occur at the tip of each finger and may appear as a series of small black dots outlining the tip of the finger, with a branched marking at the center. Kodaloid covered intensifying screens are more apt to generate static electricity than others. Recently small black marks were appearing on some of our radiographs (Fig 5), even in the central areas of the 14 × 17 inch films. Close examination of these suggested that they

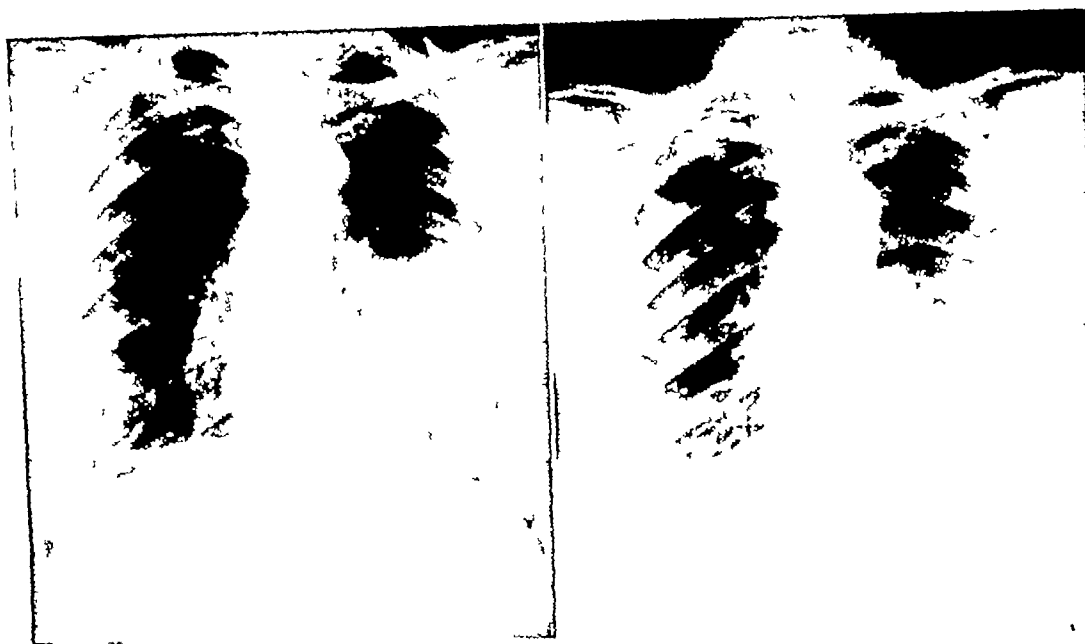


Fig 8 The shadow of the heel of the anode of a line focus tube or of a long cone may be cast on the film in such a way as to be confusing. Figure 8-A (*left*) shows a routine radiograph of a patient with pathology in the left lung and with clear costophrenic sulci. Figure 8-B (*right*) shows the same patient at the same time, but with the shadow of a long cone falling on the lower portion of the film. In some cases an erroneous diagnosis of fluid in the costophrenic sulci might be made.

over its entire surface. Or, similarly, this appearance is produced if the film is not sufficiently washed before it is put into the acid fixing bath. The developing solution is alkaline and the transference of the film to the acid fixing bath without sufficient rinsing causes effervescence. The gas thus formed under the emulsion lifts the gelatin coating and produces numerous small blisters or bubbles. Warm solutions aggravate this condition.

(I) The surfaces of the film may appear oily, a condition which is caused by the presence of fixing solution in the gelatin coating, from insufficient washing. The chemicals retained are hygroscopic and absorb moisture from the atmosphere. If the film dries up due to a drop in humidity, a white deposit will be left. Films should be washed at least fifteen minutes in running water.

(J) General foggness or streaks of varying density may be produced by oxidation of the developing solution on the film surface, incurred when the film is held out of the developing solution for

a prolonged time for inspection. High temperature of the dark room and insufficient sodium sulphite in the developing solution augment the condition.

(K) Foggness or streaks may also be produced by developer which has become contaminated by mixing, or by using the solution in a metal (not enameled steel) container or by stirring it with a metal object. An enamelware or special compound tank should be used and the stirring paddle should be of wood.

(L) A dark streak, the length of the film, may be produced by contaminated solutions dripping off of the topmost clip in the film hanger.

(M) Streaks may be produced if an insufficiently rinsed film is placed in a fixing bath that has lost its acidity. In this case development continues in streaks, and one is apt to see a metallic lustre on the film surface (by reflected light), a result of silver deposit. Such deposits will not occur if the fixing bath is acid.

(N) Blue spots or stain may be incurred through the presence of iron in combination

(C) Another source of such artefacts is the use of a freshly made developing solution in which the salts have not yet been

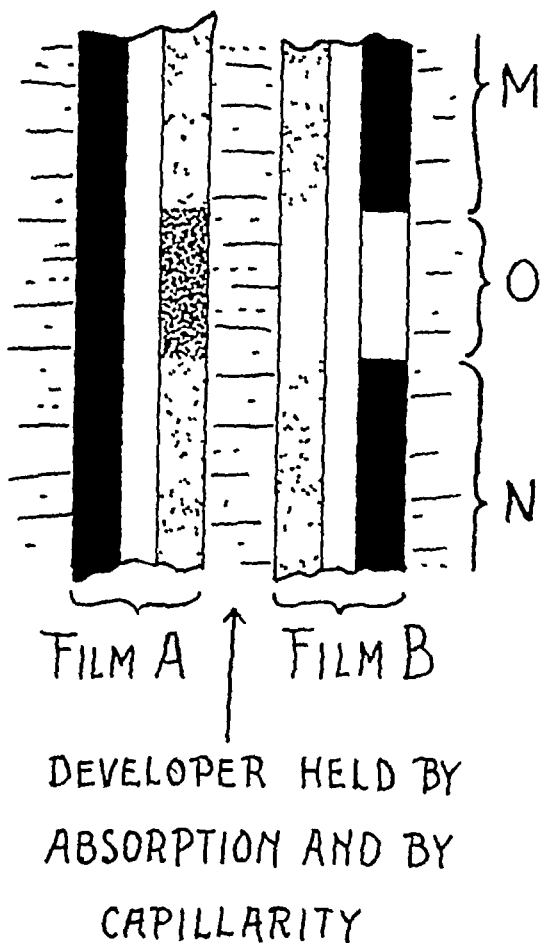


Fig 7 Film A and Film B have come together in the developing solution but are separated by an extremely thin layer of developer. The outer layers of emulsion are strongly reduced (except at zone O of Film B which was protected from the x rays), while the inner layers are incompletely reduced due to insufficiency of developer. This illustration was obtained from Robert R. Newell M.D., of San Francisco

dissolved. Round or comet-like spots may result from grains of salt settling on the film surface.

(D) The dark room technician may fail to notice that the developer does not cover the top edge of the film, in which case the finished film has a blank edge across the top.

(E) The negative image of one film may be transferred to another if the two are brought into contact after immersion in the developer, such contact as may

readily occur in a crowded tank or when a film becomes loose in its hanger. The mechanism by which this occurs is illustrated in Figure 7.² Film A and Film B have both been exposed to x-rays, but on Film B there was a protected area, O, which was not exposed. After immersion in the developer the films came in contact, leaving only a thin layer of developer between the adjacent surfaces. The outside layers of emulsion are strongly reduced, as shown, leaving a transparent spot at O on Film B where the shadow of the lead fell. Notice that the adjacent layers of the emulsion are incompletely reduced, due to insufficiency of developer. The action of the developer is divided evenly between the two emulsions, except at area O. Suppose that enough developer was caught between films to carry reduction 25 per cent to completion, as shown in zones M and N. At area O, none is used by the unexposed spot on Film B and all is thus available for Film A, which would, therefore, be 50 per cent reduced in that region.

(F) If the film comes in contact with the side of the tank, incomplete development of the emulsion over this area will result.

(G) Small air bubbles attaching themselves to the film as it is placed in the developer will result in under-developed spots at these points. Since only one side of the emulsion is affected, the marks are not very distinct. If the air bubbles attach themselves to the film after development has started, the marks will appear dark.

(H) It is good practice to use an acetic acid short stop bath between the development and fixing of the films because this neutralizes the basic reaction of the developer and thus protects the acid of the fixing bath. If the acetic acid is too strong (proper strength is 3.5 ounces of glacial acetic to a gallon of water), minute elevations on the emulsion will be produced.

I am indebted to Robert R. Newell M.D. Professor of Medicine (Radiology), Stanford University Medical School for this explanation of Figure 7 and for other suggestions in this paper.

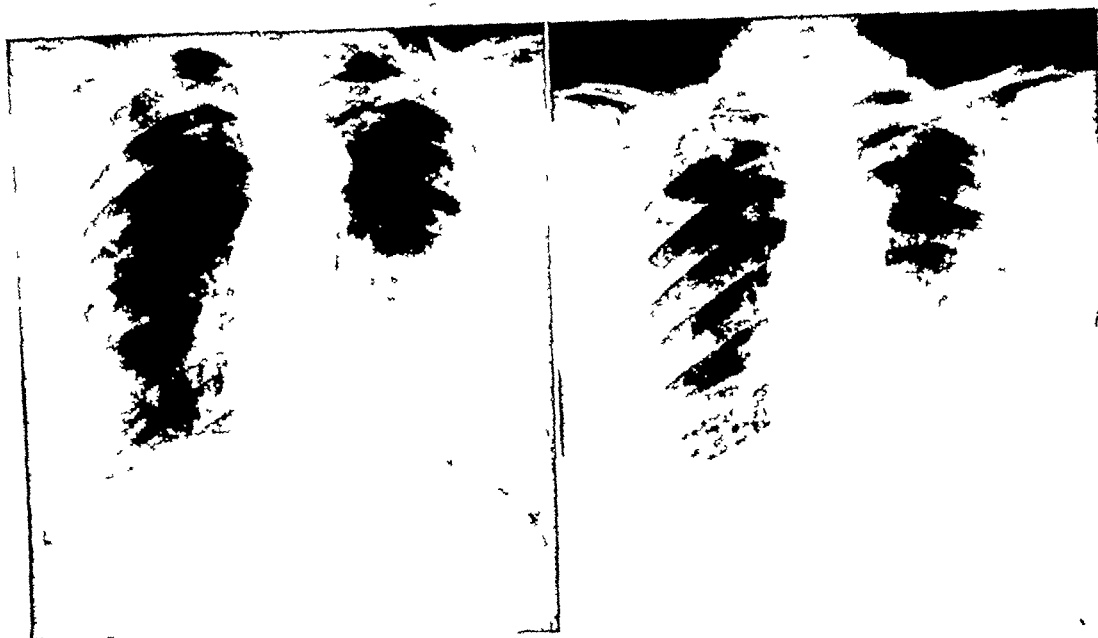


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(N) Blue spots or stain may be incurred through the presence of iron in combination

with Farmer's reducer. These may be removed by immersing the film in a 5 per cent solution of potassium oxalate.

V — OTHER CAUSES

Irregularly shaped transparent marks may be produced by barium sulphate on the front side of cassettes, on the covering of the Potter-Bucky diaphragm, or in the grain of the veneer table top through which the exposures are made. Irregular markings may also be produced by wrinkles in the skin, warts, fibromas, adhesive tape, iodoform and other opaque powders or ointments. Braids of hair may cast a shadow. Even a thin silk night-dress may show on the film because it is weighted with tin or barium, whereas a thick cotton cloth is less apt to show. A nurse's fingers may cast very disturbing shadows. Artefacts arising from dirt, bits of paper or injuries on the double intensifying screens are very frequent, and can be recognized by the extreme sharpness of their edges. It is possible for bits of metal (a flake of nickel plating from the spring of the cassette, for example) to get behind the front screen. A shadow will be cast on the film and yet the bit of metal not be visible to the eye.

A portion of a radiograph may be blurred while the rest of it is sharply defined, due to poor contact between the intensifying screens and film. Contact may be tested by placing a fine wire mesh immediately on top of the cassette and then exposing to x-rays from a tube about forty inches away. After the film has been processed, poor contact is easily detected by fuzziness of some of the wire shadows. Incidentally, a good idea of the resolving power of the screens may be obtained from this same film.

The parallel lines of the Potter-Bucky diaphragm grid are easily recognized. If the tube is off the Potter-Bucky diaphragm center, a cutting down of x-ray intensity or even complete blocking occurs on the portion of the film which is farthest off center. In certain line focus tubes, the angle be-

tween the central ray and the target face is sufficiently narrow to permit the production of an important artefact. The shadow of the "heel" of the anode may be projected on a chest film in such a place as to permit of the possibility of an erroneous diagnosis of fluid in the costophrenic sulci. In Figure 8 such a shadow was produced by a cone. A dark spot on a film may be produced by a hole in an aluminum filter.

Fog may be produced by faulty intensifying screens which have a very large lag. To test this, cover one-half of a film on both sides with black paper and place it for twenty-four hours in a cassette which has recently been exposed to x-rays. Develop the film without exposure and if the uncovered portion of the film shows fog, the screens are at fault. Fog may also be produced by accidental exposure to light, by extraneous light entering the dark room, or by prolonged exposure to the safelight. Safelights are designed for bulbs of a given candle power, and are "safe" for a definitely limited exposure. If a higher candle power bulb is inserted, due allowance must be made for the increased tendency to fog.

Irregular markings on films, usually are noticeable by reflected light, are produced by scum on the solutions. Where organic matter is present in the water used in mixing the solutions, scum is likely to form. It should be removed from the solutions the first thing in the morning by skimming with strips of blotting paper.

Deterioration of x-ray film from moisture usually produces a granular appearance, which may show up as parallel lines found to correspond to the corrugations of the film box packing. Sometimes evidence of the moisture can be seen on the outside of the film box.

I wish to express my appreciation for the assistance given me by Mr. Charles W. Smith, representative of the Eastman Kodak Company and to Mr. R. K. Perrine, of the du Pont Film Company, for two of the illustrations.

ONE THOUSAND SPHENOIDS EXAMINED IN BOTH THE GRANGER AND MENTO-VERTEX POSITIONS¹

By AMÉDÉE GRANGER, M D , *New Orleans*

ALREADY, in 1932, we had summarized briefly a comparative study² of about forty sphenoids, examined in both the Granger and mento-vertex positions. Since then we have examined over a thousand sphenoids, 633 from March 15 to June 15, 1933, and 394 from May 1 to August 1, 1934, all of which were radiographed in both the Granger and mento-vertex positions.

This intensive study convinced us more than ever of the diagnostic value of the Granger line and we do not fear contradiction when we state that by a careful study of that line alone a correct roentgen diagnosis of the condition of the sphenoid sinuses can be made in at least 95 per cent of the cases examined.

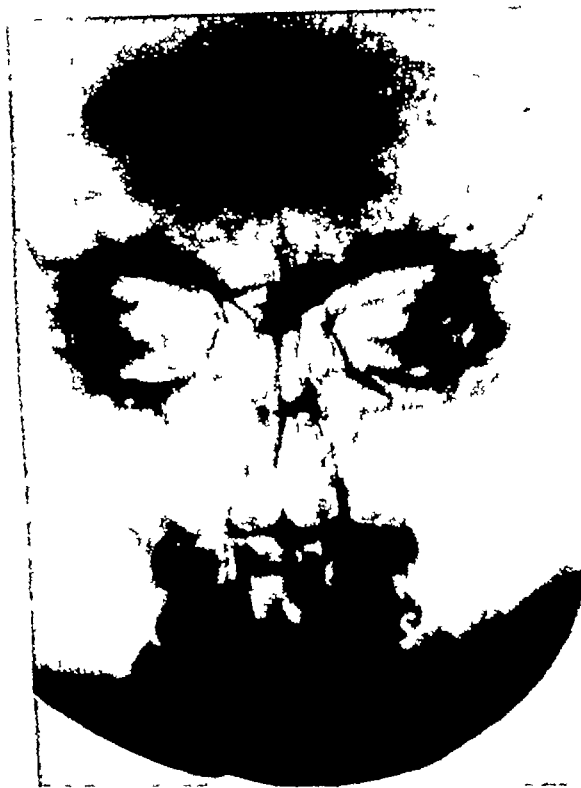


Fig 1-A Small amount of pus in the right sphenoid diagnosed by the obliteration of the mesial portion of the right half of the Granger line. Radiograph made in the Granger position



Fig 1-B Small amount of pus in the right sphenoid which could not be differentiated from a mild degree of hyperplasia, capable of causing the slight increase in density on the right sphenoid. Radiograph made in the mento-vertex position of the same case as in Figure 1-A

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¹ Presented as a clinic before the Radiological Society of North America, at the Twentieth Annual Meeting in Memphis, Tenn., Dec 3-7, 1934.

² Radiological Study of the Paranasal Sinuses and Mastoids. Lea & Febiger

As previously stated in our monograph, this study, which confirmed our experimental work with the filled skulls, has



Fig 2-A (*upper left*) Hyperplastic sphenoiditis on the right side. Diagnosed by the rarefaction, broadening, and indistinct lower edge of the right half of the Granger line. Radiograph made in the Granger position.

Fig 2-B (*upper right*) Right-sided hyperplastic sphenoiditis which cannot be diagnosed because both sphenoids are clear. Radiograph made in the mento-vertex position of the same case as in Figure 2-A.

Fig 3-A (*lower left*) Cancer of the right naris. The marked opacity of the right sphenoid would certainly indicate gross pathology of that sinus. Radiograph made in the mento-vertex position.

Fig 3-B (*lower right*) Cancer of the right naris. The clear and distinct Granger line rules out any pathology in the sphenoid sinuses. Radiograph made in the Granger position of the same case as in Figure 3-A.

proven to us that radiographs made in the mento-vertex position, first, do not have positive and readily identified boundary landmarks for the sphenoid and ethmoid, and second, that perfect duplicate radiographs of the same head are rarely obtainable. The position is more uncomfortable and, if the neck is short and—what is not uncommon in cases of arthritis—if the neck is stiff, it is extremely difficult and even at times impossible to make satisfactory radiographs in the mento-vertex position.

The superiority of the Granger position was even more manifest when the radiographs were studied for signs of healthy and diseased conditions of the sphenoids.

In the mento-vertex radiographs, the sphenoids show either clear or more or less opaque. A very slight degree of opacity such as might be caused by a small amount of pus in one sphenoid or by a slight or moderate degree of hyperplasia of its lining membrane can be detected only if the other sphenoid appears clear, and even then it is impossible to say which of these two pathologic processes is causing the slight opacity. We need not insist upon the value of this information to the otolaryngologist.

We have been able to recognize a small amount of pus in the Granger radiograph (Fig 1-A) because of the obliteration of part of the Granger line by the pus flowing against it in a correctly made radiograph, which could not have been diagnosed in the mento-vertex radiograph (Fig 1-B).

This diagnosis was confirmed in some cases by the appearance of the Granger line after therapeutic drainage, with relief of the clinical symptoms, and in other cases by the appearance of the Granger line in

radiographs made with a faulty technic, *i e*, by tilting the tube instead of the head of the patient to the required angle, in which case the pus flows against the anterior wall of the sphenoid and not against the anterior portion of its roof, *i e*, the Granger line (Figs 15 and 16 in the author's "Paranasal Sinuses and Mastoids")

We have also repeatedly made the diagnosis of hyperplastic sphenoiditis (Fig 2-A) when the Granger line was either broadened, rarefied, indistinct, or shaded along its lower edge. This condition could not be diagnosed in the mento-vertex radiograph (Fig 2-B).

Of course extensive pathology such as large quantities of pus, extensive hyperplasia, or granular or polypoid changes, with or without pus, cause opacity of the diseased sphenoid in both radiographs, but in addition the Granger line is always obliterated on the diseased side in our radiographs. We must remind you that a clear and distinct Granger line with sharp edges means a healthy sphenoid.

We have seen not a few opaque sphenoids in mento-vertex radiographs (Fig 3-A) which were not caused by disease of those sinuses but by marked occlusion of the naris from carcinoma (Fig 3-A), from extensive polyposis, and even from greatly hypertrophied turbinates, when the presence of a clear or even a fairly distinct Granger line in radiographs made in our position (Fig 3-B) positively and correctly ruled out any pathology of the sphenoid other than a slight or moderate amount of hyperplasia of its mucosa. This was later confirmed at operation or after painstaking rhinological investigation.

SOME REFLECTIONS ON THE ETIOLOGY OF KOHLER'S DISEASE

By DR A ZEITLIN, *Moscow, U S S R*
State Institute of Radiology

Translated from the French by E T LEDDY, M D

THE localization of the lesions in Kohler's disease differs from those of other osseous affections of a juvenile osteochondropathic type in that the whole metatarsal head which is involved may be removed surgically without greatly interfering with the function of the foot. This operation, carried out for therapeutic reasons, has allowed us the opportunity to study in several cases the pathologic anatomy of the changes in the bone. Nevertheless, a very detailed study of the histologic picture has given us no clew to the underlying cause of this disease. Concerning this point there is in the literature nothing but hypotheses, more or less solidly established, based on the opinions of the various authors.

The microscopic changes in the metatarsal head in the earliest stages of the disease of Kohler II present the histologic picture of an aseptic necrosis of bone, followed by fracture, differences of opinion begin when the attempt is made to explain this necrosis. Some hold that it is the result of a repeated traumatism (Kappis, Freiberg, and Speed), others, that it results from a micotic embolism of the small vessels (Althausen), a third group claims that it results from an endarteritis of the vessels of the periosteum and of the capsule (Konig and Rauch, Rosner and Weil, Holst and Chandrikoff), a fourth group states that the process is a fibrous osteitis, a tuberculosis, an osteomyelitis, etc. It should be mentioned that several authors are of the opinion that a local cause is not sufficient to explain the changes in the involved bone, so they add supplementary factors to the local status of the bone, such as some special constitutional predisposition (Liek and Altschul), or some endocrine disturbance (Bragard and Fromm  ), or finally the manition or exhaustion of the body's reserve following

some severe disease (Alberti, Holst and Chandrikoff, and Kienboch). However, in reviewing the histories of patients with Kohler's disease we find that in the majority of instances there was no confirmation of these theories. G Reinberg was quite certainly correct when he wrote, in 1926, that all discussion of the bodily constitution and of the internal secretions in Kohler's disease be stopped, for such are nothing but the prevailing fashions in medicine. Here one might make the exception of a "gracious" constitution with fragile bones and weakened muscles. In this case the diminution of mechanical resistance and an increased vulnerability of the tissues would favor the development of a local process in the metatarsus, statistical evidence showing that this affection is most common in adolescence and in the female sex. It is possible also that a general debility of the body which has been noted in some cases would have the same effect. However, the possibility of modifying this constitutional factor, that of age and sex, is proven by the fact, noted by G Reinberg and confirmed by us, that K  hler's disease does not occur in dancers and young girls who have been trained in institutes of physical culture, a fact which is explained by the systematic exercise of the legs and the harmonious development of the muscles.

All of these considerations lead to the conclusion that it seems more logical and plausible to look for some local process as the cause for Kohler's disease which is a local lesion, as, for example, the functional laxity or the insufficiency of the osteo-muscular mechanism of the foot. The importance of the static and mechanical condition of the body in the development of K  hler's disease has drawn the attention of investigators for a considerable length of time. Among these

conditions we do not take seriously the height of the heel of women's shoes, which has been the subject of much attention in the literature as a cause of this disease, for the fact remains that millions of women wear high-heeled shoes while the incidence of Kohler's disease is extremely low. According to the author's way of thinking, the structural and anatomic peculiarities and variations in the make-up of the foot are of much more importance. Almost all authors, regardless of how they regard the nature of this affection, assign a certain importance to the overloading ("surcharge") of the anterior portion of the foot, in fact, some authors state that this overloading is the main factor in the etiology of the lesion. Engelman, Baensch, Lang, During, Sonntag, and others have pointed out the importance of flat foot in causing Kohler's disease. Momburg is of the opinion that, in walking, at the moment the heel is lifted the principal overload falls on the second metatarsal, which is the commonest site of the lesion. Holst, Chandrikoff, and others state that at the moment the heel is lifted the imprint of the anterior portion of the sole is deepest in the region of the head of the second metatarsal.

Our attention was called to the question of the etiology of Köhler's disease during a radiologic study of the changes in the foot in Deutschländer's disease, *pied forcé*, or march foot, according to the terminology of various authors. Our attention was drawn by the fact that these two changes frequently appear in the foot of the same subject. We have six such cases in our personal records, and we have encountered three others in the literature among the radiographs of patients with Deutschländer's disease. Of great interest are the publications of Axhausen and Schnee who have observed both conditions in the same metatarsal bone. One naturally thinks, therefore, that there is some relationship or a parallelism in the two affections, an idea that was advanced by Bragard and Schnee. In our opinion this relationship is due to the identity of

the causes which favor the development of the lesion in one or the other portion of the metatarsus.

Like the majority of English and French authors, we do not think that Deutschländer's disease is a separate nosologic unit. The condition which we have been recently calling a separate disease entity is none other than a lesion first described, in 1855, by Breithaupt, and known in different countries by different names, such as syndesmitis metatars, osteoperiostitis metatars, march foot, Marschfraktur, *pied forcé*, etc. The most important characteristic of this affection is the overloading of the foot (*pied forcé*, of the French authors). The acute or subacute development of this disease is generally preceded by some anatomic changes which indicate the structural and functional weakness of the bones of the foot, these changes may be detected in the radiograph. A Morton has given us the following outline of these changes: (1) shortening of the first metatarsal, (2) backward displacement of the sesamoids, (3) enlargement of the space between the first and second cuneiforms, (4) thickening of the medial border of the first metatarsal, (5) thickening of the diaphysis of the second metatarsal. We have found these signs of Morton in different combinations in the greater part of 18 radiographs of *pied forcé* which we have had the opportunity of studying. In reviewing the radiographs of patients with Kohler's disease we have found these same signs of Morton in a considerable number of cases. In 22 radiographs of patients with Köhler's disease which we have studied we found shortening of the first metatarsal three times, displacement of the sesamoids 14 times, enlargement of the space between the cuneiforms 16 times, thickening of the border of the first metatarsal 16 times, and thickening of the third and fourth metatarsal 19 times. In three radiographs these signs were not definite and in only three instances were they completely absent.

These findings lead us to suppose that

in the etiology of Kohler's and Deutscher's diseases the weakening of the foot or its overloading play a very important rôle. The difference in localization of the two conditions may be explained to a certain extent by the age of the patient. An alteration in the head of the metatarsal is due to the fact that it develops earlier here than in the diaphysis. In our own cases, and in those we have cited from the literature in which we had a combination of the two conditions and in which we found changes in the diaphysis, the important changes in the head of the metatarsal were already present. One might suppose that the head of the metatarsal, rich in spongy tissue and covered by a thin cortical layer, would be the first to suffer, and it is only with advancing age when it has become more resistant that the changes involve the diaphysis. It is just at this period when an increase in body weight exerts greater stress on the metatarsus.

The pathologic anatomy of the process in the head of the metatarsal in the disease of Köhler II may be explained other than that it is a necrosis due to obliteration of vessels. In a study by the aid of the spectroradiograph of the fine structure of bone both normal and "overloaded," Henschen found changes in the latter similar to those which are found on analysis of "stressed" metal. There are changes in the groupings of the crystalline system at the point where the pressure is greatest, and also the formation of a line or a zone of slipping along which finally there are formed fine fissures and gaps. This process is the forerunner of the formation of microscopic and macroscopic fractures, and the destruction of the trabeculae of the bone. Finally these changes take on the appearance of compression fractures of the spongy tissue resulting from a long-continued pressure. The process may be compared to that which is observed in the spondylitis of Rummel-Verneul in which the settling of the body of the vertebrae does not occur until a long time after the trauma.

Kohler's disease is often compared with Legg-Calvé-Perthes' disease, but we feel that the analogy to Kienböck's disease of the semilunar bone is closer. In both these affections the process takes place in a bone already formed, possessing a spongy structure and a thin cortical, whereas in Legg-Calvé-Perthes' disease we have an infantile epiphysis of the femur in the process of growth, rich in cartilage and in the elements of new-formed bone. Therefore, the successions of osseous changes noted radiologically in the head of the metatarsal (Kohler's disease) and in the lunate bone (Kienböck's disease) are completely analogous. The same is true of the osseous deformities in the two affections, while the possibility of a complete restoration to normal is a characteristic of Perthes' disease. The etiobiologic factors in the two conditions seem to be identical and the rôle of micro-traumatism in Kienböck's disease has been emphasized by that author on many occasions.

Because of the insignificant rôle which the cartilage plays in the pathologic changes in the two affections, might it not be more correct to speak not of osteochondropathy but of osteopathy (micro-traumatic osteopathy)? By the theory of weak foot, and the overloading of the foot in Kohler's disease the fact that the changes are most frequent in the second metatarsal is easily explained, even though they may also occur in the head of the third or fourth metatarsal. In the radiograph of the foot the prominence of the second metatarsal in comparison with the others can be easily seen in the majority of cases. G. Reinberg admits the rôle of walking or rather the position of the axis of flexion of the foot in regard to the direction of movement. Morton develops in a more detailed way the study of weak foot and of the overloading of the foot. According to him, in walking or in standing the heads of all the metatarsals touch the ground equally, but the load which each one of them carries depends on the division of weight, which, in turn, depends on the particular make-up of the foot in question.

In weak foot and in exaggerated pronation the center of gravity of the body is shifted from its normal position between the first and second metatarsals, more externally and corresponds to the position of the third or fourth metatarsal more than to that of the second. The metatarsal most traumatized thereby is, therefore, the one most affected.

The question of the thickening of the metatarsal diaphysis in Kohler's disease is rarely discussed, the fact is simply stated without being explained. As we have just stated, Morton includes thickening of the diaphysis of the second metatarsal among the symptoms of weak foot, and sees the cause of this fact in a compensatory hyperostosis as a result of a chronic overloading of the involved foot. Accordingly, the change in the heads of the third and fourth metatarsals produces the thickening of the corresponding diaphysis, that is to say, the one which has the greatest stress.

We have pointed out elsewhere the probable rôle of the interosseous muscles in the development of this hyperostosis. According to Jansen, these muscles which are inserted along the whole of the metatarsal diaphysis take a very important part in the act of walking by fixing the metatarsals to the phalanges, and *vice versa*. When static conditions are changed this reciprocal relationship is changed also, in the sense that there is an increase of work thrown onto those interosseous muscles which are inserted into the most affected metatarsal. The permanent tension placed on the periosteum leads to its hyperplasia and thickening, with a resulting reconstruction of the bone in the involved zone.

According to Hackenbroch, one observes frequently a thickening of a metatarsal which is congenitally short, or one which has been shortened operatively. The author explains this fact as due to an excessive overload.

Our radiographs of Kohler's disease have come to us from different institutes, a fact which has hindered us from getting an exact clinical history of the age at which the lesion started and the way in which it developed. Nor have we been able to clear up the questions about the thickening of the metatarsal, whether it occurs simultaneously with the changes in the head, or after them. We have radiographs in which the changes in the metatarsal are relatively recent (stages 1 and 2), in which the hyperostosis is well pronounced, and others of analogous cases with very little thickening of the diaphysis, or even none at all. In the more advanced stages (3 and 4) the hyperostosis is present in most cases.

Therefore in Kohler's disease an anatomical or structural weakness of the musculature of the foot, with an exaggerated overloading of one of the metatarsals, is one of the important causes of the changes which take place in the head of that metatarsal. Fracture is the result of overloading of the bone which results from molecular changes in the fine structure of the bone, with subsequent gross changes. In young subjects it is the head of the metatarsal (Köhler's disease) which is most involved, while at a more advanced age the involvement is in the diaphysis (Deutschlander's disease). The two processes are accompanied by thickening of the diaphysis.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor*

HOWARD P. DOUB, M.D., *Associate Editor*

COUTARD'S METHOD OF TREATING CANCER BY IRRADIATION THERAPY

Coutard, of Paris, in 1920 began the treatment of cancer by irradiation therapy, using a technic of his own, based on principles obtained by certain experimenters. In one instance it was observed experimentally that a dose of x-rays large enough to sterilize a rabbit's testicle produced a necrosis of the skin when given in a single dose. However, when given in five equal doses, administered at intervals over a period of from thirteen to seventeen days, it produced sterilization but without destruction of the skin. In other words, while the effect on the embryonic cells was about the same the skin was not damaged.

Coutard reports that between the years of 1920 and 1926 he treated about 216 cases of throat malignancies, most of which were inoperable, with the result that 20 per cent of the cases treated were symptom-free at the end of five years.

These excellent results of Coutard's treatment have been the cause of numberless radiologists using his method in the treatment of cancer of the throat. In many instances, however, certain modifications of his technic were deemed advisable, principally because his method of treatment is a prolonged and expensive procedure and for this reason can be applied in but a few of the large medical institutions. However, the reports from the various modifications of his method are most gratifying.

Coutard's method of irradiation is now being applied in malignancies other than those of the throat, and the results are apparently the same.

The intense interest manifested in this form of treating cancer has been the occasion of calling together some of the outstanding radiologists of the country in a discussion of this subject at the Fiftieth Anniversary of the Memorial Hospital, New York City. We append hereto the result of this conference which is most edifying and instructive.

A SYMPOSIUM ON THE TREATMENT OF PHARYNGEAL CANCER BY THE DIVIDED OR PROTRACTED DOSE PRINCIPLE OF EXTERNAL RADIATION

Edited by HAYES E. MARTIN, M.D., *and* MAURICE LENZ, M.D., *New York City*

On May 25, 1934, as a part of the program at the Fiftieth Anniversary Celebration of the founding of the Memorial Hospital, New York City, a symposium was held on the divided or protracted dose principle of external radiation in the treatment of pharyngeal cancer. There were present, as active participants in this symposium, the following: W. Edward Chamberlain, M.D., Temple University Hospital, Philadelphia; Edwin C. Ernst, M.D., St. Louis; G. Failla, D.Sc., Memorial Hospital, New York City; Maurice Lenz, M.D., Presbyterian and Montefiore Hospitals, New York City; Hayes E. Martin, M.D., Memorial Hospital, New York City; Walter L. Mattick, M.D., State Institute for the Study of Malignant Disease, Buffalo; Edwin A. Merritt, M.D., Warwick Cancer Clinic, Garfield Memorial

Hospital, Washington, D.C., and Bernard P. Widmann, M.D., Philadelphia General Hospital, Philadelphia.

Each of the above-mentioned investigators gave a ten-minute description of his technic, after which the following treatment factors were discussed separately, and in turn:

- 1 Sources of radiation
 - (a) X-rays
 - (b) Radium element packs
- 2 Physical factors of x-rays and radium packs
 - (a) Kilovoltage
 - (b) Milliamperage
 - (c) Radium content
 - (d) Target-skin distance or radium-skin distance
 - (e) Filter

- 3 Total treatment period in days
- 4 Interval of treatments (daily, twice daily, every other day, etc.)
- 5 Size of individual dose or daily dose in roentgens
- 6 Size, number, position, and shape of skin portals
- 7 Total dose in roentgens
- 8 Reactions in the skin and mucosa
- 9 Anatomic varieties of cancer treated
- 10 Histologic varieties of cancer treated
- 11 Combination of interstitial radon with divided doses of external radiation

It was hoped, thereby, to secure a cross-section of the American opinion on the divided dose or protracted dose method of external radiation as it existed in 1934

In order to present the various technics, and the opinions expressed during the discussion in the most compact and available manner, the material has been condensed and edited with the hope that the reader might, thereby, be spared a great deal of time and effort in obtaining exact information as to this symposium's discussions and opinions

1 *Sources of Radiation*—All observers had used mainly x-rays in the neighborhood of 200 K V. Martin reported the use of 700 K V x-rays in a few cases. Martin, Mattick, and Widmann also reported the use of radium element packs in a limited number of cases

2 *Physical Factors of X-rays and Radium Packs* (a) *Kilovoltage*—Most of the x-rays used were in the neighborhood of 200 K V, the variation being from 160 K V, constant potential (Chamberlain), to 220 K V peak (Merritt). The apparent reason for the choice in this regard was that in all clinics the highest voltage available was used. Ernst recommended that in reporting voltage, one should refer to the effective voltage, rather than kilovolts peak. Chamberlain stated that physical measurements indicate that a constant potential source at 160 K V produces an x-ray beam having a shorter effective wave length than 200 K V peak from a pulsating generator. At the Memorial Hospital, the 700 K V machine, though highly desirable in this method of treatment, can take care of only a small percentage of the cases requiring treatment

The radium packs used at the Memorial Hospital, New York City, and the Buffalo State Institute contain four grams, and that used at the Philadelphia General Hospital, two

grams of radium. The relatively long time required for individual treatments by these radium packs makes it impossible to care for more than a small percentage of the cases requiring treatment by the divided dose method in any of these clinics

(b) *Milhamperage*—Practically all observers had originally used 200 K V x-rays at 4 to 5 milliamperes. Lenz had originally used both 4 and 8 milliamperes. Lenz, Martin, Mattick, Merritt, and Widmann had subsequently also employed from 20 to 30 milliamperes, which they preferred because the higher milliamperage permitted a shorter treatment time (8 to 10 minutes, as against 40 to 80 minutes) in the individual treatments. With a limited number of treatment units of the higher intensities, four to five times as many cases can be treated, and the patients can be spared the fatigue and discomfort of such comparatively long exposures

Of those who had used both amperages, all except Lenz were of the opinion that there was little, if any, difference in the physiologic effect between the two, with equal doses expressed in roentgens. Lenz believed that there was better ultimate recovery of the skin and subcutaneous tissues with the use of the lower intensities, especially in the use of large fields. Chamberlain had used only 5 milliamperes, and was unwilling to increase his current factor because of Coutard's insistence upon the paramount importance of a low r-afflux in this type of work. Gendreau, in the general discussion, stressed this point. Failla suggested that the difference in intensity and treatment time as between 4 and 30 milliamperes was hardly sufficient to account for a different physiologic effect

(c) *Target-skin Distance or Radium-skin Distance*—In no cases had distances less than 50 centimeters been used with x-radiation. Chamberlain, Ernst, Lenz, Martin, and Mattick had used distances up to 80 centimeters. It was agreed that distances greater than 60 to 80 centimeters are neither necessary nor economically sound

In the use of radium element packs, both 6 and 10 cm radium-skin distances had been employed. Widmann had used a distance of 4 cm in a few cases. Martin stated that distances greater than 10 cm would undoubtedly be advantageous, but since a radium pack dose, equivalent physiologically to about 350 to 400 r with 200 K V x-rays would require at least

two hours (8,000 mg-hr) with a 4-gram element pack at 10 cm, it is readily understood why great distances are impractical, when daily treatments of such lengths must be given over a period of from 20 to 30 days or longer¹

(d) *Filter*—There was some difference of opinion as to the best thickness of filter. Most of those present had used a filter of 2 mm of Cu (or its equivalent) plus a secondary filter of 1 to 2 mm of Al (Chamberlain, Ernst, Lenz, Merritt, and Widmann). This thickness of filter was used because of the conviction that the quality of the beam was thereby rendered harder and (with equal depth doses) less damaging to the skin than less heavily filtered γ -radiation.

Martin and Mattick had used filters of 0.5 mm Cu + 1 to 2 mm of Al on the basis of Failla's investigations. Failla stated that his physical investigations indicated that the *quality* of a beam of γ -rays produced at 200 K V is not materially improved by the use of a greater filter than 0.5 mm of Cu, although the *quantity* is, of course, reduced by greater filters. It was his opinion that the use of 2 mm of Cu filter with 200 K V γ -rays is, therefore, wasteful from the economic standpoint. Those using heavier filters were of the opinion that Failla's physical conclusions were not borne out by clinical observations.

Mattick and Merritt had used Thoria filters in a few cases, on account of their theoretical advantages. Martin reported that with 700 K V γ -rays, Failla had recommended a filter of 5 mm of Cu on economic grounds, which had thereafter been used in all treatments by this unit. With the radium element packs, a filter of from 2 to 3 mm of brass or its equivalent had been used in all cases.

3 *Total Treatment Period in Days*—The consensus of opinion was that a treatment period of from 20 to 30 days was best in the average case of pharyngeal cancer. Lenz preferred a treatment period of 30 days or longer in all cases. Martin had formerly used shorter treatment periods of from 10 to 14 days, which he had discontinued in favor of a longer, 20- to 30 day period (excluding Sundays), extending it to 40 to 50 days in certain radioresistant growths outside the pharynx.

¹ Using the inverse square law as a rough basis for calculating dosage a dose of 8,000 mg-hr at 10 cm, given in two hours would correspond to 18,000 mg-hr at 15 cm and a treatment time of four and one-half hours. A daily treatment of such length would hardly be practical.

Merritt employed a treatment period of 20 days (excluding Sundays) in most cases, but in a few instances had extended treatment over about 50 days. Chamberlain also reported the use of 50- to 60-day periods in a few cases. It was the majority opinion that unusually long periods (over 30 days) are not advantageous in the average case of pharyngeal cancer. In some cases, Widmann had used two 10 day treatment periods separated by a rest interval of two weeks.

4 *Interval of Treatments (Daily, Twice Daily, Every Other Day, Etc.)*—As a general rule, all speakers preferred to give one treatment per day to alternate skin portals on either side of the pharynx. In the case of more than two portals cross firing on the same lesion, the portals were irradiated, one per day, in rotation. There was no report of the administration of two treatments daily with an interval of several hours' rest between treatments, as recommended originally by Coutard. Chamberlain preferred daily treatments, including Sundays and holidays, and insisted upon each portal receiving a daily dose. He stated that the administration of 300 r to right and left portals on alternate days was distinctly less rational than the daily administration of 150 r to each side. Martin reported giving treatment to two portals daily in the case of widely separated lesions, such as to the nasopharynx and a cervical metastasis, in which cases, one portal each to the cheek and one to the neck would be treated each day. There was no report of deliberately interrupting the sequence of treatments for several days before completing the series, except by Widmann, who had more recently changed his technic to an interrupted series.

5 *Size of Individual Dose or Daily Dose in Roentgens*—The size of the daily dose depended to some extent on the size of the skin portal. All dosages mentioned below are expressed in roentgens measured at the longest target-skin distance, and in air without back-scattering.

Chamberlain, using fields of from 50 to 300 sq cm, treated right and left portals daily, 110 r to each. In a general way, such a daily dose of 110 r to each side may be compared with a dose of 220 r, administered to alternate sides on alternate days. He based his insistence concerning the smaller daily dose to each portal, upon his belief that there is more skin recovery during the first twenty-four hours than during the second.

Ernst also treated two portals daily, giving 200 r to an 8×10 cm portal to the side of the lesion, and 100 r to a portal of the same size on the side opposite the lesion. After 20 days, in some cases, he gave 20 daily treatments of 100 r each to a posterior portal.

Lenz varied the dose, depending on the necessary size of the skin portal. With portals varying from 6×8 cm to 10×10 cm, he gave from 300 to 400 r daily. He had used 500 r daily with fields of 6×8 cm, but had discontinued such dosage, and advised against it. Lenz and Martin both advised a moderate variation of the daily dose with average portals, depending on the tolerance of the patient and the reaction of the primary lesion.

Martin, using smaller circular portals, 7 to 8 cm, whenever possible, gave an average daily dose of 350 r. This daily dose may vary from 300 to 400 r with portals varying from 6 cm to 10 cm in diameter. With the 700 K V x-rays, larger daily doses of 400 to 450 r were tolerated with about the same physiologic effect as the above-mentioned doses at 200 K V. Mattick, using large fields in mostly all cases (10×15 cm), gave daily doses to alternate portals of 320 r. Merritt had used daily doses of from 200 to 300 r, depending on the size of the field, 8×10 cm to 10×15 cm. Widmann had used a daily dose of 300 r, irrespective of the size of the field (10×10 to 10×20 cm).

6 Size, Number, Position, and Shape of Skin Portals—The size of the skin portals varied from 6×6 cm to 10×20 cm, although there seemed to be a considerable preference for smaller portals, whenever possible. Chamberlain, Ernst, Lenz, Martin, and Merritt definitely expressed their preference for smaller portals, although it seemed to be the general feeling that portals of about 7 to 8 cm in diameter are about as small as can be safely used to treat a single lesion at a depth. Smaller portals than this are too difficult to localize and become misdirected if the patient moves even slightly during treatment. Mattick and Widmann had used larger portals in all cases, 10×10 cm, 10×15 cm, and 10×20 cm.

Chamberlain, Lenz, Martin, and Mattick employed at least two opposing lateral portals in practically all cases. Ernst, Merritt, and Widmann had also occasionally used one portal only on the side of the lesion. When two or more portals were used, they were usually treated in rotation, except by Cham-

berlain, who insisted upon daily treatments to each and every portal. Widmann had used various plans, sometimes irradiating one portal on one side for ten consecutive days, and then, either with or without a rest period, giving the portal on the opposite side a series of daily consecutive exposures.

In most cases, two opposing fields had been used, but Ernst and Lenz occasionally employed two contiguous fields on the side of the lesion, in addition to one on the opposite side, so as to cross-fire the site of the primary growth. Martin had used two contiguous fields in some cases for irradiating the maxillary antrum.

Martin recommended circular, rather than square or oblong skin portals. These circular fields are obtained by the use of metal cones varying in size from 6 to 12 cm in diameter. He discussed his reasons for the use of circular rather than square portals, as follows. The average growth of the pharynx is roughly spherical in shape, and although one diameter may be longer than the other, the direction of the long diameter can seldom be so accurately determined that it will fit in with the long diameter of an oblong portal. Therefore, since tumors must be considered theoretically spherical (rather than square or oblong), a circular portal is more logical. Another reason for the use of a circular, rather than a square portal, is the comparative efficiency or usefulness of the two shapes of skin portals having equal diameters. The surface area of a circular portal is 20 per cent less than a square portal of equal diameter, and being equally efficient, the circular portal should, therefore, conserve the general tolerance. These theories were illustrated by diagrams.

7 Total Dose in Roentgens—Chamberlain brought up for discussion the method of expressing the total dosage when several skin portals of the neck had been irradiated to cross-fire a pharyngeal lesion. He contended that if the number of roentgens received by the several portals were added to form a grand total, such a figure would be meaningless in attempting to describe the dose of radiation received by the individual case. He recommended that the total dosage be expressed by stating the individual dose in roentgens received by each portal, and its size. This method of expressing dosage was concurred in by all.

Taking a 20- to 30-day treatment period, as

of average length, and a skin portal 7 to 8 cm in diameter (50 to 60 sq cm), as of average size, the most common total dosage was about 3,500 r to each side of the pharynx. A smaller portal, a longer treatment time, unusual tolerance by the patient, or resistance of the disease were considered as reasons for larger doses (above 3,500 r to each side). The converse of the above conditions were indications for smaller doses (below 3,500 r to each side). It was agreed that smaller doses are generally insufficient.

8 *Reactions in the Skin and Mucosa*—It was generally agreed that marked reactions in the skin and mucosa are essential in order to obtain complete regression in most pharyngeal cancers. Pfahler, in the general discussion, asked for an expression of opinion from the members of the symposium as to what specific degree of radiation reactions should be purposely produced in the skin and mucous membranes of the neck and pharynx in the treatment of pharyngeal cancer by this method. It was generally agreed that in most cases, such reactions did and should go on to an acute blistering or epidermical reaction in the skin, and the formation of a pseudo diphtheritic membrane in the mucosa. Such reactions in the skin and mucosa are quite tender, but are not painful while at rest. They usually heal after from two to four weeks without difficulty.

9 *Anatomical Varieties of Cancer Treated*—Most of the reports were concerned with the treatment of pharyngeal and laryngeal cancer only, although Mattick reported the use of the method in nasal cancer. Martin reported the extension of its use to growths of the floor of the mouth, paranasal sinuses, nasal cavity, and nasopharynx.

10 *Histologic Varieties of Cancer Treated*—There was general agreement to the effect that favorable results were to be expected in most pharyngeal and extrinsic laryngeal growths, whatever the histologic type, although as a general rule, well differentiated epitheliomas and adenocarcinomas are less sensitive than the more anaplastic growths. Histologic grading is of presumptive, but not of absolute value in estimating beforehand the response to radiation. It was also definitely pointed out that no case should be excluded from this type of treatment because of its histologic character, if the primary lesion is situated in the pharynx. Pfahler, in the general discussion, was of the opinion that histologic grading is of little value in outlining treatment.

11 *Combination of Interstitial Radium with Divided Doses of External Radiation*—Ernst and Widmann reported that they had had no permanent results from the combination of interstitial radiation with the divided dose method of external radiation. These two investigators reported that local slough resulted in most cases in which interstitial radiation was used as an adjunct, Lenz emphasized the dangers of radionecrosis, but stated that he had obtained a few successful results by the combination of methods.

Martin and Mattick both reported good results by this combined technique, and stated that they often planned such a combination of methods on beginning the treatment of an individual case. Martin admitted the frequency of local necrosis, but had found seeds of great value for residual disease in the primary lesion, or in neck nodes, and also for neck nodes widely separated from the main skin portal. He stated that he believed necrosis to be a serious complication in the hypopharynx or larynx, but less so in the oral cavity or upper pharynx. He also suggested that by a combination of external and interstitial radiation, less than the maximum doses of either method alone may be successfully employed with a greater margin of safety.

Gendreau, in the general discussion, stated that he believed the exact technique, as published by Coutard (filter, distance, kilovoltage, milliamperage, size of portal, size of daily dose, etc.), should be followed in all cases, if the general technique employed is to be termed the "Coutard method." In the following discussion, it seemed to be the general opinion that Coutard had not settled upon any exact technique, and that although he should be given full credit for his original observations, and the discovery of a new principle in radiation, the best technique of the divided dose or fractional dose principle had not as yet been settled.

COMMUNICATIONS

COMPULSORY HEALTH INSURANCE

The following communication has been received from the Medical Society of the State of New York concerning a matter so pertinent to all physicians that RADIOLOGY is glad to pass it on to its readers.

Albany, N. Y., Feb. 24, 1935 "The acid

test of experience condemns compulsory health insurance schemes wherever they have been tried," stated Dr Arthur J Bedell, President of the Medical Society of the State of New York here to-day, in opposing the bill now pending in the State legislature

"The medical profession disapproves of the proposed law because this method of handling medical care is damaging to the patient and disastrous to the doctor

"This protest does not mean opposition to the policies of the administration in its recovery efforts or in any other phases of the 'New Deal' However, physicians as a class are better qualified to speak than any other group, as to the effects of a compulsory health insurance law on the community The Medical Society of the State of New York, representative of the physicians of the State, rejects the project It will not work It will bring to the community conditions quite the opposite of the expectations of its well-wishing proponents "

Dr Bedell pointed to the utter failure of compulsory health insurance in Germany, where it has been tried for half a century He said that Gustav Hartz, labor economist of Berlin, and author of several books on Germany's social politics, has analyzed the fallacies of the scheme and exposed to the world the harm, rather than good, that compulsory health insurance has actually produced Dr Bedell stated that this report, entitled, "Will America Copy Germany's Mistakes?" will be published in the March 1 issue of the "New York State Journal of Medicine" as translated from the German by the Pennsylvania Self-insurers' Association of Philadelphia

"Sick insurance," according to the report, "provides the workman with medical attendance free of charge, with medicine and other necessities, and with an allowance Anyone will at first sight consider this a great blessing for the workman as well as for national health The reality, however, is far different

"The insured workman becomes a second-class patient The mass demand compels a limitation in the use of medicines Doctors must not prescribe what they consider good for the patient, they are allowed to give only remedies entered in a book of medical regulations for insurance purposes

"Dread of illness obsesses most people and this has been pressed into a system 'illness made easy' by which the will to be well is strangled The doctor is consulted a dozen times where once would be sufficient—the insurance pays

The prescribing of medicine and bandages is desired When they have been obtained they lie about until they are no longer fit to be used—the insurance pays Besides, it is nice to get something in return for the premiums paid year in and year out There is developed a fear of illness which shakes the will for recovery—the best aid to health Pretenders and hypochondriacs are bred and the use of medicine becomes excessive

"Medical science has become a cheap article and doctors have given up conscientious treatment The genuine patient is neglected, is not given the necessary care The greater the mass consultation, the lower are the doctor's fees They are, therefore, compelled to resort to mass practice

"All this is at the workman's expense, for the part of the premiums supposed to be paid by the employer is in reality borne by the workman either as a consumer or wage earner As the employer's premium share is immediately connected with the wage, it is shifted over on the wage In Germany, no one any longer doubts the fact that the employer's share of the premium is taken from the workman's wages What the employer pays as his contribution, he cannot pay the workman in the form of wages

"A network of deception has been spread In millions of cases wrong was turned into right and the gates opened wide to fraud When wages are being decreased, when work is scarce, and work hours shortened, when there are fewer shifts, many holidays, sick insurance comes in handy One objects to the work he is given, another does not feel like working Matters soon make an extensive controlling system necessary This ends in badgering all persons

"Patients are visited in their homes by controlling officials who have to convince themselves that the patient is really ill and not doing any work The sick insurance engages so-called confidential doctors who have to submit the patient to a final examination to see whether he is too ill to work The results of such examinations are to a great extent startling Here is one instance from among thousands 2,008 patients were ordered to appear for a final examination 816 of them at once declared their complete recovery, 289 were found to be well by the confidential doctor So nearly half of them were not ill at all

"The confidential doctor is, so to say, the medical policeman, who not only controls the patients but also his fellow-doctors who are treating them

"The genuine patient is justly indignant to find that the existence of his illness is doubted, and that he who has always paid his premiums regularly and has a right to demand conscientious attendance, is considered a cheat

"This system, together with the rest of the bureaucratic apparatus, has wedged itself between doctor and patient, completely destroying the patient's confidence in his physician, which greatly retards all recovery

"Those who know anything about the actual working of compulsory health insurance will not be surprised that the confidential doctor, whose task it is to keep the number of patients low, may declare a patient recovered, who nevertheless dies two days later "

FEE TABLES AND THE ROENTGENOLOGISTS¹

By LMMET KLATING, M D, *Chicago*

The Chicago Roentgen Society has a disturbing problem which is partly a manifestation of this changing world, but which is mostly a misapprehension on the part of the medical profession as to the status of a roentgenologist

For several years the profession has been in receipt of published fee tables from both x-ray and clinical laboratories. Physicians have never questioned the custom but rather have been inclined to regard it with favor. It makes it convenient for them to answer questions of patients relative to the cost of the work the physician wishes to have done. The custom practically sets an arbitrary price that must be met by all laboratories and does not take into account the ability of the roentgenologists to perform the work. The problem of the roentgenologist is further complicated by hospital competition. Hospitals must have x-ray departments and should also have the best that there is in the way of a roentgenologist

It is most unfortunate that many physicians consider the roentgenologist a mere photographer. Some of them are. All of the competent men in that specialty resent the implication but to no avail. It is a sentiment as deeply rooted in the minds of the profession as is the belief on the part of the laity that the best doctors are the ones who have the greatest number of patients. The roentgenologists

know how this misconception on the part of the profession can be set right, but they are too modest to suggest the way out of the humiliating situation in which they find themselves

No self-respecting physician would refer a patient to an ophthalmologist who would prescribe glasses when glasses are not needed. Neither is a physician humiliated when an ophthalmologist tells the patient that glasses are unnecessary. The patient is perfectly satisfied to pay the ophthalmologist a fee for his advice and the family doctor has not suffered from loss of confidence on the part of the patient. This well established attitude held by the public, the family doctor, and the ophthalmologist is due to the fact that none of the parties concerned think of the ophthalmologist in terms of a set of trial lenses. The ophthalmologist is considered a capable physician who has confined his work to the care of the eyes. Because of the imposing magnitude of the x-ray machine, the roentgenologist, as a learned physician, is over-shadowed and lost to view

The roentgenologists are expected to take the picture or pictures indicated by the family doctor. They are not supposed to question the referring doctor's opinion as to what part of the body should or should not be x-rayed. Many a patient with heart disease, not discovered by the attending physician, is sent to the roentgenologist with instructions to make a complete gastro-intestinal radiological study that is entirely unnecessary. If the roentgenologist dared to assert himself, the family doctor would receive an x-ray picture of the chest, with the accompanying report, and a frank and fearless statement of there being no indications for doing a gastro-intestinal series.

I believe that in all cases, other than minor fractures, the attending physician should furnish the roentgenologist with a careful history of the patient and the roentgenologist should make a partial physical examination that will enable him to judge what pictures should or should not be made. If this is done, the number of unnecessary pictures at present being taken will be greatly reduced.

The charge by the roentgenologist should be made on exactly the same basis as that of any other physician, namely, the time and the skill required and the ability of the patient to pay. Roentgenologists are most co operative in this respect, and physicians should restrain them-

¹ Reprinted from the Chicago Medical Society Bulletin, Jan 26, 193

selves from looking for x-ray bargains in order to save the patient a few dollars. The attending physician is the best judge of the patient's ability to pay and it is his duty to impart this information to the roentgenologist.

It might be a good plan if at least once a year, a meeting of the Chicago Medical Society were devoted to discussion of what is a reasonable fee. There are many physicians whose estimates are too low, while, on the other hand, there are some physicians who obtain fees from comparatively poor people that are entirely out of proportion to the service rendered. Practices of that kind are often responsible for the lay opinion of the medical profession that was recently expressed by Mr. O'Brien in his column in the *Chicago Daily News*.

It should not be difficult to understand that if physicians will consider the roentgenologist in the same light they consider the ophthalmologist or the otolaryngologist, the problem now confronting the roentgenologists will be solved. The sending of fee tables will be evidence that the sender brands himself as one who renders an inferior service.

DOSAGE FACTORS

Roentgenologists doing therapy are urged to familiarize themselves with the Recommendations of the International Committee for Radiological Units (see *RADIOLOGY*, November, 1934, 23, 580), to the end that reported results may be reproducible by others. The advantages to be derived from the use of a uniform technique, such as may be reported in dosage factors known to all, are manifest. Follows a list of those factors which should be recorded in reporting therapy results, and which one needs to know in order to follow the successful courses of others:

- (1) Number of roentgens (r) delivered to each treatment area (measured in free air)
- (2) Dosage rate (rate of applying the radiation, r/min)
- (3) Equivalent voltage
- (4) Filter—material and thickness (also include approximate tube wall thickness)
- (5) Distance (skin to target)
- (6) Interval between irradiations
- (7) Size and number of ports of entry

In this connection, therapists are referred to the Report of the Committee on Standardization of X-ray Measurements in *RADIOLOGY*, March, 1934, 22, 289.

ANNOUNCEMENTS

ANNUAL MEETING, 1935

The Executive Committee have chosen Detroit, Michigan, for the 1935 meeting place of the Radiological Society of North America. The meeting will be held in the Hotel Statler, December 2 to 6, 1935.

PAN-AMERICAN MEDICAL ASSOCIATION'S CRUISE FOR 1935

The *S S Columbia*, the largest American cruise ship afloat—40,000 tons, with three swimming pools and a sand beach on deck—has been selected by the officials of the Pan-American Medical Association for the cruise. The ship will sail from New York on July 18, returning to New York on August 28. The itinerary will be as follows: New York, Havana, Curaçao, five days at Rio de Janeiro (where a scientific congress will be held), three days at Santos (for attending a scientific convention at Sao Paulo), Trinidad, Santo Domingo, Kingston (Jamaica), Havana, and New York.

Accommodations per person are from \$450.00 up, which is as low as \$11.00 a day.

This will be an unusual opportunity to combine a wonderful vacation with recreation, education, good fellowship, and good health. The Section on Radiology is one of the live members of the Association. Its President is Frederick W. O'Brien, M.D., 465 Beacon St., Boston, Mass., who invites you to contribute some article on radiology. Please say that you will go, and send in your title within thirty days, if possible.

For further particulars of the cruise, write to the Director-General, Joseph J. Eller, M.D., 745 Fifth Avenue, New York City.

ALBERT SOILAND, M.D.
Chairman Executive Committee,
Section of Radiology

PAN-AMERICAN MEDICAL ASSOCIATION

The Sessions of this Association have proven to be of great scientific value, while the fellowship of leading spirits in all specialties of medicine has resulted in a better understanding and mutual respect. Under the leadership of Frederick W. O'Brien, M.D., President of the

"The genuine patient is justly indignant to find that the existence of his illness is doubted, and that he who has always paid his premiums regularly and has a right to demand conscientious attendance, is considered a cheat

"This system, together with the rest of the bureaucratic apparatus, has wedged itself between doctor and patient, completely destroying the patient's confidence in his physician, which greatly retards all recovery

"Those who know anything about the actual working of compulsory health insurance will not be surprised that the confidential doctor, whose task it is to keep the number of patients low, may declare a patient recovered, who nevertheless dies two days later "

FEE TABLES AND THE ROENTGENOLOGISTS¹

Bj EMMET KEATING, M D , Chicago

The Chicago Roentgen Society has a disturbing problem which is partly a manifestation of this changing world, but which is mostly a misapprehension on the part of the medical profession as to the status of a roentgenologist

For several years the profession has been in receipt of published fee tables from both x-ray and clinical laboratories. Physicians have never questioned the custom but rather have been inclined to regard it with favor. It makes it convenient for them to answer questions of patients relative to the cost of the work the physician wishes to have done. The custom practically sets an arbitrary price that must be met by all laboratories and does not take into account the ability of the roentgenologists to perform the work. The problem of the roentgenologist is further complicated by hospital competition. Hospitals must have x-ray departments and should also have the best that there is in the way of a roentgenologist

It is most unfortunate that many physicians consider the roentgenologist a mere photographer. Some of them are. All of the competent men in that specialty resent the implication but to no avail. It is a sentiment as deeply rooted in the minds of the profession as is the belief on the part of the laity that the best doctors are the ones who have the greatest number of patients. The roentgenologists

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¹ Reprinted from the "Chicago Medical Society Bulletin," Jan 26, 1935

BOOK REVIEW

THE HEART VISIBLE A CLINICAL STUDY IN
CARDIOVASCULAR ROENTGENOLOGY IN
HEALTH AND DISEASE By J. POLEVSKI,
M.D., attending physician and cardiologist,
Newark Beth Israel Hospital. Published
by F. A. Davis Co., Philadelphia, 1934.
A volume of 207 pages, with 122 illustrations. Price \$5.00.

The crying need for an English-language monograph on the roentgen examination of the heart and great vessels is evident to any one who has had any contact with this field. This small book is, therefore, welcome, in spite of the disappointment occasioned by the inadequacy of its treatment of the subject. If it be assumed that it is intended for students and clinicians who are relatively unfamiliar with roentgen methods, it may well fulfill its purposes, it is doubtful, however, whether it will be very helpful to the mature roentgenologist. When an author discusses a circumscribed subject, such as this one, it does not seem unreasonable to expect that it be considered completely. There is an immense literature in this field, and numerous volumes concerned with it have appeared both in German and French, the opportunity to present accurate and detailed information on every phase of the matter is thus readily afforded. The effort to compress the text into a small space defeats the very purpose of any reference book, and in this instance prevents complete fulfillment of this opportunity.

The book contains 183 pages of text and is well printed and well illustrated. Certain sections, such as that on the pathologic physiology of mitral disease and on the effects of extrinsic factors on the heart, are very well presented. On the other hand, the discussion of the methods of examination and their relative value is much too brief. Certainly the

measurement of cardiac area and its relation to height and weight is dismissed too casually.

The actual errors are relatively infrequent although attention should be directed to a few of the more prominent ones. The statement that the third curve on the left border of the heart is due to the left atrium or its appendage should at least have been qualified, if the author was unwilling to accept the recent refutations of this oft-repeated error. Likewise the statement that enlargements of the right ventricle can hardly be seen in postero-anterior views is probably incorrect. In fact, the author's own consideration of the enlargement of the heart in mitral disease tends to disprove both of these propositions.

The omissions are much more numerous, and a few of the more glaring ones may be noted. The use of diagrammatic cross-sections would clarify the section on anatomical relations. There is no mention whatever of the roentgenoscopic findings in pericardial effusion, and the treatment of this condition is most inadequate. There is no reference to the roentgen observation of calcification of the valves of the heart or of the coronary arteries. There is an implied pessimism as to the roentgen diagnosis of aortic aneurysm which is hardly justified. No mention is made of aneurysms of the ascending aorta extending to the left, and the effects of aneurysms on the esophagus are hardly considered. The many valid objections to the Kreuzfuchs method of measurement of the aortic arch are not brought out, giving a somewhat false idea of the value of the method. There is a rather insufficient discussion of the differential diagnosis of various heart conditions.

The author has presented his material attractively and the errors are insufficient to detract from the value of the book. It may well be recommended as an introduction to the study of the roentgen diagnosis of cardiovascular disease.

Section on Radiology for North America, and of Albert Soiland, M D, Chairman of the Executive Committee for North America, the interests of radiology will be ably taken care of

The officers for North America are Chevalier Jackson, M D, of Philadelphia, *President*, Harlow Brooks, M D, of New York City, in charge of the Surgical Division, Lewellys F Barker, M D, of Baltimore, in charge of the Medical Division, Charles H Mayo, M D, of Rochester, Minn, among the Vice presidents, Hugh H Young, M D, of Baltimore, in charge of the Genito urinary Section, Douglas Quick, M D, of New York City, in charge of the Section on Neoplastic Diseases

The officers of the Executive Committee for the Section on Radiology are as follows *President* Frederick W O'Brien, M D, *Vice-presidents* Leon J Menville, M D, B R Kirklin, M D, Edwin C Ernst, M D, Byron H Jackson, M D, Edward W Chamberlain, M D, *Secretary* John Sproull, M D, *Executive Committee* Albert Soiland, M D, George E Pfahler, M D, George W Grier, M D, Ernst A May, M D, Amédée Granger, M D, Harry M Imboden, M D, and Benjamin H Orndoff, M D

AN AWARD

A David Anderson-Berry Gold Medal, together with a sum of money amounting to about £100, will be awarded in July, 1935, by the Royal Society of Edinburgh to the person, who, in the opinion of the Council, has recently

produced the best work on the nature of x rays in their therapeutic effect on human diseases. A similar award will be made every three years

WILLIAM DUANE

IN MEMORIAM

We are deeply grieved to announce the recent death of Dr William Duane, of Philadelphia, one of the world's best known physicists, who has done so much for advancing the science of radiology.

Dr Duane was born in Philadelphia in 1872. He received his A B degree from the University of Pennsylvania in 1892, in 1893 he also received an A B degree from Harvard University, his Ph D degree was obtained from the University of Berlin, Germany, in 1922 the honorary degree of Doctor of Sciences was conferred by the University of Pennsylvania. He was a member of the Cancer Commission of Harvard University and Research Fellow since 1913. He served on the international committee for the establishment of the r-unit. Among his numerous contributions to science, his work on the x-ray spectra of light elements has given him world-wide publicity.

The Radiological Society of North America and the Journal RADIOLOGY mourn Dr Duane. He was an Honorary Member of the Radiological Society of North America and received the Society's Diploma.

His loss will be felt by many, but surely none could feel his loss greater than the radiologists of this and other countries for whom he has done so much.

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 S M ATKINS M D, of Waterbury, Connecticut
 J E HABBE, M D, of Milwaukee
 HANS W HEFKE, M D of Milwaukee

DAVIS H PARDOLL, M D, of Chicago
 E A POHLE M D, Ph D, of Madison Wisconsin
 CHARLES G SUTHERLAND, M D, of Rochester, Minn

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Two Cases of Juvenile Osteitis Deformans Paget
Rudolf Hummel Röntgenpraxis, August, 1934, 6,
513-519

Schmorl did not see any cases of Paget's disease in patients under 40 years of age in his large autopsic material. There have been reports of cases under 30 years of age in the literature. The author reports two cases in children, 11 and 9 years of age.

In the first case the right femur showed the typical roentgenologic appearance of Paget's disease with a pathologic fracture. The pelvis was also involved. The boy was seen several times during the course of five years, with pathologic fractures. A biopsy proved the diagnosis of osteitis deformans Paget.

The second case (9 years) was not proved by biopsy, but showed typical sclerosis and deformities in the pelvis, femora, and other bones.

The formation of callus took place in a normal way in both cases. X ray therapy was tried in one patient with no benefit.

HANS W HEFKE, M D

CALCULI

Some Newer Conceptions of Urinary Stone Formation
J D Barney and E R Mintz Jour Am Med Assn, Sept 8, 1934, 103, 741-743

These authors discuss the association of hyperparathyroid disease and renal calculi. If hyperparathyroidism is in the nature of an endocrine dysfunction, it must be generalized throughout the body and the urinary tract. Why then, does it not result in stones in all cases or in bilateral stones uniformly? The fact that it does not would indicate that there must be some still unknown factor at work in the kidney itself which prevents stone formation in certain cases. By the same reasoning, there must be a local renal factor that induces unilateral stone in certain individuals and bilateral stones in others. Perhaps a still more intensive study of the colloids will supply the answer. Possibly dietary and vitamin deficiencies or errors will be found to play a part more than seems now to be the case. Also it may be possible that infection or even stasis will come to be regarded more seriously. That some disturbance of metabolism plus a factor or factors existing at least temporarily in one or both kidneys, is at work seems a plausible working hypothesis. The realization that hyperparathyroidism will account for at least a part of the problem is important and encouraging. Further studies by the endocrinologist and the biochemist, as well as by the physiologist will eventually succeed in solving the question of urinary stone formation.

CHARLES G SUTHERLAND M D

CANCER (DIAGNOSIS)

The Early Diagnosis of Carcinoma of the Small Intestine. Karl Hohenner Röntgenpraxis, October, 1934, 6, 677-679

There is only one method which allows the diagnosis

of malignant infiltration in the small intestine before the appearance of symptoms of obstruction the roentgenologic examination. A case is described in which a carcinoma was diagnosed roentgenologically at a relatively early stage. The diagnosis was possible by a break in the mucosal folds, without dilatation of the involved portion of the intestine. It is interesting to note that the patient had had an exploratory laparotomy two weeks before the roentgenologic examination at which the tumor had not been found.

HANS W HEFKE, M D

CANCER (THERAPY)

Management of Cancer of the Mouth and the Cervical Lymphatics Douglas Quick Am Jour Roentgenol and Rad Ther, March, 1934, 31, 366-377

Treatment of intra-oral cancer embraces the primary growth and the usual paths of metastasis. Intra-oral cancer includes epidermoid carcinoma of the oral mucosa, maxillary antrum, and structures of the tonsillar fossa.

Treatment of Primary Tumor—External irradiation is best. A few may yield completely to this method alone, usually there is regression only, and treatment must be completed by interstitial irradiation. For surface irradiation, radium has no place. For interstitial irradiation, radon seeds are best, especially in gold capillary tubes. With proper technic, necrosis is rare.

The influence of tumor histology is not as great in this class as in others but valuable, nevertheless. Grades III and IV, except in the tonsil are rare. Relatively few are anaplastic. In the tonsil group, many are anaplastic and external irradiation only is indicated. Oral hygiene is very important even if, to accomplish it it is necessary to hospitalize the patient. Feeding must be kept up with a nasal tube, if necessary. When syphilis is present as a complicating factor, the cancer is treated first gently, later, when it has been controlled, it may be treated in the usual fashion. If necessary, a cautery is used—for access to the tumor-bearing area, to produce drainage, or when there is invasion of bone. In the antrum the anterior wall and adjacent alveolar process is removed for implantation of the seeds. In the floor of the mouth implantation is made first before cautery removal of diseased tissue. This includes osteomyelitis of bone or revision of the scar in the syphilitic area, or any scar that threatens to break down or produce deformity.

Treatment of the Cervical Lymph Nodes (Metastatic or Uninvolved)—Dissection *en bloc* is now not indicated, especially on account of its limitations and the better results produced with radiation therapy. Anaplastic epidermoid carcinoma is controlled or destroyed completely by external irradiation alone. Complete and partial undifferentiated growths tend to widespread distribution and multiple metastasis early in their course, like glandular types of cancer.

Complete unilateral neck dissection should be re-

AGRANULOCYTOSIS

Agranulocytic Leukopenia Report of a Case Successfully Treated with X rays and Some Observations on the Effect of Amidopyrine. *Julien E. Benjamin and Joseph B. Biederman Jour Am Med Assn July 21, 1934 103, 161-163*

Severe and repeated attacks of agranulocytosis have been reported as early as 1931 in an individual using large amounts of coal tar derivatives. Kracke suggested that the benzene chain contained in the drugs might act as a powerful leukocytic depressant.

The authors report a severe granulopenia the result apparently of self medication with amidopyrine. The patient was immediately given high voltage roentgen therapy over the long bones and the effect was most impressive. There was a prompt alleviation of the severe aching, the fever gradually receded, and there was an early restoration of the white count to normal standards. The patient had several attacks all associated with the use of one of the coal tar derivatives. All were amenable to roentgen therapy. The patient was shown to have an idiosyncrasy to amidopyrine.

CHARLES G. SUTHERLAND, M.D.

THE APPENDIX

The Pathological Appendix Joseph Felsen. *Am Jour Roentgenol and Rad Ther, March 1934, 31, 340-345*

This article is concerned with the correlation of the clinical and microscopic findings of various types of appendiceal pathology as compared with the radiographic appearance of the barium filled appendix determined immediately after surgical removal the appendix being carefully filled with a heavy suspension of barium in 5 per cent formalin. In the early acute lesion the wall shows slight thickening, while the canal presents a saw tooth or stalactite appearance. In the late acute the wall is thickened or perforated, while the canal shows stenosis or widening. The chronic or healed case shows a thickened or atrophic wall with widening stenosis or obliteration of the lumen.

J. E. HABBE, M.D.

BONE DISEASES (DIAGNOSIS)

The Differential Diagnosis of Osteitis Deformans (Paget's Disease) and Syphilis of the Bone T. Camigiani and K. Singer. *Röntgenpraxis August, 1934 6, 500-512*

Paget's disease and syphilis of the bone are sometimes impossible of differentiation both clinically and roentgenologically. The case described by the authors showed a marked sclerosis of the shaft of the right femur definite widening periosteal thickening and a coarse structure of the medulla, with formation of cysts. The other bones were negative. The diagnosis of Paget's disease was made, but in consideration of the irregular thickening of the periosteum the localization of the process in the diaphyses without involvement of the ends of the bone and the absence of pathology of other bones the diagnosis was changed to diffuse syphilitic osteitis. A biopsy showed changes typical

of Paget's disease. The patient however, became much improved after anti syphilitic treatment, and the authors believe that syphilis was the correct diagnosis.

HANS W. HEFKE, M.D.

Paget's Disease as an Accidental Finding T. Bársony and K. Winkler. *Röntgenpraxis November 1934, 6, 730-734*

Paget's disease is much more common than one heretofore has believed. In Schmorl's pathologic institute it was found in 275 per cent of the patients. Several cases of unsuspected Paget's disease are reported in some of which only one or only a few bones were attacked. In the highest percentage of cases the vertebrae and sacrum were involved, but there was also a localized osteitis deformans in the clavicle.

The frequency of Paget's disease in living patients needs to be determined because there is a great discrepancy between roentgenologic and pathologic percentages. The matters of age and first findings of Paget's disease have to be investigated. The question of sarcomatous degeneration has yet to be settled. Some authors believe that it takes place in about 2 per cent of the cases but this percentage is probably too high. Early diagnosis is possible only by roentgen examination and a trial of roentgen therapy might be indicated if the lesion is confined to one bone.

HANS W. HEFKE, M.D.

Roentgenographic Studies of Parathyroid Deossification John J. Moore and Alfred A. de Lormier. *Am Jour Roentgenol and Rad Ther April, 1934, 31, 490-511*

Deossification was studied experimentally under varied conditions namely parathormone administration, ammonium chloride (acid), sodium bicarbonate (alkali) relation of either acid balance or alkaline balance to parathormone effect, thyroid extract and disuse atrophy. Clinically observed manifestations of deossification were applied to osteitis fibrosa multiple benign giant-cell tumors, and osteitis deformans.

The state of osseous metabolism is conspicuously manifested in the metaphyseal regions of the long bones. A thyroid extract and acid balance regimen was seen to synergize the effects of parathormone and independently each was seen to effect a marked increase in the inorganic phosphorus excretions. Sodium bicarbonate was seen to inhibit the action of parathormone, as suggested by biochemical studies of Stewart and Haldane.

Reossification was observed after imposing a high calcium intake plus a relatively alkaline balance.

Clinically the manifestations of progressive deossification are emphasized by a multiplicity of osseous dissolutions—cases of osteitis fibrosa or multiple cystic formations and cases of multiple benign giant-cell tumors. Closely related would seem to be those cases manifesting reossifications—such as osteitis deformans. In extreme cases of the latter there would appear to have occurred alternate deossifications and reossifications—in some cases perhaps a cyclical hyperparathyroidism.

S. M. ATKINS, M.D.

Two Cases of Juvenile Osteitis Deformans Paget
Rudolf Hummel Röntgenpraxis, August, 1934, 6,
513-519

Schmorl did not see any cases of Paget's disease in patients under 40 years of age in his large autoptic material. There have been reports of cases under 30 years of age in the literature. The author reports two cases in children 11 and 9 years of age.

In the first case the right femur showed the typical roentgenologic appearance of Paget's disease with a pathologic fracture. The pelvis was also involved. The boy was seen several times during the course of five years, with pathologic fractures. A biopsy proved the diagnosis of osteitis deformans Paget.

The second case (9 years) was not proved by biopsy, but showed typical sclerosis and deformities in the pelvis, femora, and other bones.

The formation of callus took place in a normal way in both cases. X ray therapy was tried in one patient with no benefit.

HANS W HEFKE M D

CALCULI

Some Newer Conceptions of Urinary Stone Formation
J D Barney and E R Mintz Jour Am Med Assn, Sept 8, 1934, 103, 741-743

These authors discuss the association of hyperparathyroid disease and renal calculi. If hyperparathyroidism is in the nature of an endocrine dysfunction, it must be generalized throughout the body and the urinary tract. Why then, does it not result in stones in all cases or in bilateral stones uniformly? The fact that it does not would indicate that there must be some still unknown factor at work in the kidney itself which prevents stone formation in certain cases. By the same reasoning, there must be a local renal factor that induces unilateral stone in certain individuals and bilateral stones in others. Perhaps a still more intensive study of the colloids will supply the answer. Possibly dietary and vitamin deficiencies or errors will be found to play a part more than seems now to be the case. Also it may be possible that infection or even stasis will come to be regarded more seriously. That some disturbance of metabolism, plus a factor or factors existing at least temporarily in one or both kidneys, is at work seems a plausible working hypothesis. The realization that hyperparathyroidism will account for at least a part of the problem is important and encouraging. Further studies by the endocrinologist and the biochemist, as well as by the physiologist will eventually succeed in solving the question of urinary stone formation.

CHARLES G SUTHERLAND M D

CANCER (DIAGNOSIS)

The Early Diagnosis of Carcinoma of the Small Intestine. Karl Hohanner Röntgenpraxis, October, 1934, 6, 677-679

There is only one method which allows the diagnosis

of malignant infiltration in the small intestine before the appearance of symptoms of obstruction. The roentgenologic examination. A case is described in which a carcinoma was diagnosed roentgenologically at a relatively early stage. The diagnosis was possible by a break in the mucosal folds, without dilatation of the involved portion of the intestine. It is interesting to note that the patient had had an exploratory laparotomy two weeks before the roentgenologic examination at which the tumor had not been found.

HANS W HEFKE, M D

CANCER (THERAPY)

Management of Cancer of the Mouth and the Cervical Lymphatics. Douglas Quick Am Jour Roentgenol and Rad Ther, March, 1934, 31, 366-377

Treatment of intra-oral cancer embraces the primary growth and the usual paths of metastasis. Intra-oral cancer includes epidermoid carcinoma of the oral mucosa, maxillary antrum and structures of the tonsillar fossa.

Treatment of Primary Tumor—External irradiation is best. A few may yield completely to this method alone, usually there is regression only, and treatment must be completed by interstitial irradiation. For surface irradiation, radium has no place. For interstitial irradiation radon seeds are best, especially in gold capillary tubes. With proper technic, necrosis is rare.

The influence of tumor histology is not as great in this class as in others but valuable, nevertheless. Grades III and IV, except in the tonsil are rare. Relatively few are anaplastic. In the tonsil group many are anaplastic and external irradiation only is indicated. Oral hygiene is very important, even if to accomplish it it is necessary to hospitalize the patient. Feeding must be kept up, with a nasal tube if necessary. When syphilis is present as a complicating factor the cancer is treated first gently, later, when it has been controlled, it may be treated in the usual fashion. If necessary, a cautery is used—for access to the tumor-bearing area, to produce drainage, or when there is invasion of bone. In the antrum the anterior wall and adjacent alveolar process is removed for implantation of the seeds. In the floor of the mouth implantation is made first, before cautery removal of diseased tissue. This includes osteomyelitis of bone or revision of the scar in the syphilitic area, or any scar that threatens to break down or produce deformity.

Treatment of the Cervical Lymph Nodes (Metastatic or Uninvolved)—Dissection *en bloc* is now not indicated, especially on account of its limitations and the better results produced with radiation therapy. Anaplastic epidermoid carcinoma is controlled or destroyed completely by external radiation alone. Complete and partial undifferentiated growths tend to widespread distribution and multiple metastasis early in their course, like glandular types of cancer.

Complete unilateral neck dissection should be re-

served for fully differentiated epidermoid carcinoma in patients of good general physical condition, with primary growths controlled, and in whom the metastatic nodes are unilateral, palpable, and have an intact capsule. A review of the material indicates that if dissection is to be done, it should be most radical except in cases of lip carcinoma. Removal of both submental groups and the submaxillary and upper deep cervical on the involved side is as good as the complete operation.

Influence of Histology—This is an outstanding guide to the procedure to be followed.

S M ATKINS M D

Primary Carcinoma of the Duodenum. Case Report. Paul C Swenson and Alfred G Levin. *Am Jour Roentgenol and Rad Ther* February, 1934 31, 204-207.

The authors report a case of a man aged 59, who was first examined after a period of three months during which he had suffered vague upper abdominal pain and general weakness with a weight loss of 15 pounds. A malignancy of the gastro intestinal tract was suspected although the physical findings were entirely negative. Gastro intestinal x ray examination was reported to be entirely negative, but upon review of the films at a subsequent date an alteration of the mucosal pattern in the descending portion of the duodenum was seen. The patient was moderately anemic at this time.

When re-examined 13 months later he showed a jaundice of two weeks' duration and a firm rounded mass was palpable in the right upper abdomen. X ray studies showed a filling defect of the second portion of the duodenum without any five hour gastric retention. The diagnosis was carcinoma of the common bile duct or the duodenum. At operation a mass 10 cm in diameter was palpated near the head of the pancreas. Cholecystostomy was done, but the patient died the third day after operation. At necropsy a tumor measuring 6.5 by 7 cm was found in the second portion of the duodenum with the ampulla of Vater being located almost in the center of the tumor. There was no extension beyond the limits of the duodenal wall. Microscopic examination showed adenocarcinoma of a high cuboidal and columnar epithelial type, forming irregular acini and apparently arising from the mucosa of the duodenum.

J E HABBE, M D

Alterations in the PH of the Blood in Cancer Following Roentgen and Gamma Irradiation. Janetta Wright Schoonover, Ethol Hall Shiels and Bernard P Widmann. *Am Jour Roentgenol and Rad Ther* April, 1934 31, 532-537.

There is no definite trend in PH during a course of radiation therapy.

Roentgen irradiation of uncomplicated cases with and without cancer is followed by a slight acid change in the PH of the blood within an hour of treatment, roentgen irradiation of complicated cancer cases is followed by alterations of less consistency but with a slight alkalotic trend.

The alteration within an hour of roentgen irradiation disappears within twenty four hours.

Gamma irradiation is followed by a definite alkalotic tendency, more marked just before the removal of the radon application than afterward, this alkalosis is considerably reduced after roentgen irradiation.

S M ATKINS M D

Carcinoma of the Cecum. What Are the Chances for Cure? Claude E Dixon. *Jour Am Med. Assn.* Nov. 24 1934, 103, 1605-1607.

Some persons apparently are inherently susceptible to the development of malignant processes. Examples are the multiple carcinomas, each of a distinctly different type, occurring simultaneously or consecutively in the same patient.

Malignant lesions of the colon, for the most part, are single (except those which apparently arise from malignant degeneration accompanying multiple polyposis). Radical removal is the most effective means of relief. Growth in this segment of the bowel may reach considerable size without the appearance of the phenomena of obstruction. The vast majority of cases show an anemia. Growths occurring in or involving the ileocecal valve usually produce sufficient dyspeptic symptoms from obstruction to make the diagnosis relatively easy. Those in which a mass is palpable are usually discovered by accident.

Prognosis varies with the grade of malignancy and the occurrence of metastases. Involvement of lymph glands was found in 25 per cent of the author's series of 60 cases that had survived from five to something over twenty-two years after operation.

CHARLES G SUTHERLAND, M D

CONTRAST MEDIA

Histological Studies of the Liver, Spleen, and Bone Marrow in Rabbits Following the Intravenous Injection of Thorium Dioxide. Ernst A Pohle and Gorton Ritchie. *Am Jour Roentgenol and Rad Ther* April, 1934 31, 512-519.

This is a report of a study of 80 rabbits for observation periods up to 493 days following injection of thorium dioxide. Visualization of liver and spleen is possible after the injection of from 0.5 to 1 cc of thorotrast per kilogram of body weight, which dose is tolerated without evidence of immediate injury. The shape and position of the spleen undergo many variations and the authors feel these changes, under an artificial stimulus, should be interpreted with caution. The density after 493 days did not change.

The thorotrast is seen in the reticulo-endothelial cells of the liver, spleen and bone marrow and is scattered in fine granules throughout the liver cells. The early changes in the liver are hydropic degeneration, edema of the portal spaces, and dilatation of the periportal lymphatics. Later there is usually recovery from the hydropic degeneration and a slight but definite increase in connective tissue. In the spleen an early change simulating acute splenic tumor occurs fol-

lowed later in the majority of cases by slight fibrosis. The bone marrow undergoes hyperplasia early, which is replaced eventually by exhaustion manifesting itself by a partial disappearance of the blood forming centers and serous atrophy of the fat.

The authors recommend therefore, restriction of the intravenous injection of thorotrast for diagnostic purposes to incurable cases until evidence is presented based on studies in the human demonstrating without doubt that the changes observed in the animals are not significant.

S M ATKINS, M D

COSMIC RAYS

Have Cosmic Rays Demonstrable Biologic Effects?
R. B. Engelstad *Strahlentherapie*, 1934, 51, 672

The author states that cosmic rays seem to have an inhibitory effect on growth or such biologic functions responsible for growth. On the other hand, his investigations showed that the absence of cosmic rays did not seem to have any serious effects on experimental animals (white mice).

ERNST A. POHLE, M D, Ph D

DOSAGE

Advances in the Standardization of Practical Dosage in Roentgen and Radium Therapy T. C. Neeff
Strahlentherapie, 1934, 51, 650

The author presents a series of curves and tables offering data which permit the computation of x-ray and radium doses in r.

ERNST A. POHLE, M D, Ph D

EYE (THERAPY)

Roentgen Therapy of a Post-traumatic Cyst of the Iris M. Lüdin and A. Bader *Strahlentherapie*, 1934, 51, 567

The authors treated a case of cyst in the iris which had developed following an injury. Technic: 160 K.V., 4 mm Al 23 cm F.S.D., 55 r per sitting. Six treatments were given over a period of five months. The cyst reduced in size and finally disappeared almost completely. The vision in the treated eye was good.

ERNST A. POHLE, M D, Ph D

THE FOOT

Unilateral Periosteal Thickening of the Metatarsals A. Zeitlin *Röntgenpraxis*, November, 1934, 6, 735-738

Unilateral periosteal thickening of one or more metatarsals is not, by itself, a disease, but a sign of an abnormal condition of the foot which has led to anatomical changes and must be counted in the group of symptoms of 'weak foot' described by Morton. This condition may be compensated for by adaptation of muscle and bone and may remain without symptoms. When the foot is used a great deal symptoms of a strained foot are complained of. This unilateral periosteal thickening is not only of diagnostic but also of prophylactic importance.

HANS W. HEFKE, M D

FRACTURES

Ununited Intracapsular Fractures of the Femoral Neck Roentgenographically Considered A. W. George and Ralph D. Leonard *Am Jour Roentgenol and Rad Ther*, April 1934, 31, 433-441

Statistics show that treatment of these fractures result in non-union or non-bony-union in 45 to 70 per cent. The apposition of the fragments is very important, owing to the absence of the periosteum. However, the blood supply is probably not greatly interfered with, since the ligamentum teres blood supply is adequate. The apposition of these fragments can be demonstrated by the 'vertical view' with the use of the curved cassette. This view is stressed as being essential in every fracture of this type. Most of these fractures are of the leverage type and, therefore, impacted fractures are rare. It is felt that the vast majority of intracapsular fractures have not been properly reduced. The direct fractures are usually extracapsular or trochanteric and usually show coxa valga deformity, with little displacement, and a high percentage of bony union.

In a series of 20 consecutive intracapsular fractures, manipulations on the leverage theory resulted in over 70 per cent bony union. The maneuvers are in their order, extension, adduction, internal rotation, and abduction. The study of old ununited fractures with the 'vertical view' shows that absorption of the neck is uncommon, and, therefore, reveals possibilities in the chronic cases.

The authors feel that the large percentage of non-union or non-bony-union is due to lack of adequate apposition of the fragments and that the 'vertical view' will result in better alignment. A greater percentage of cases of union are proven by their own series.

S M ATKINS, M D

GALL BLADDER (NORMAL AND PATHOLOGIC)

The Applied Physiology of the Extra-hepatic Biliary Tract A. C. Ivy and G. S. Bergh *Jour Am Med Assn*, Nov 17 1934, 103, 1500-1504

The gall bladder manifests like the intestine three types of activity: absorption, secretion, and motor activity. In the process of absorption, the gall bladder concentrates the hepatic bile that enters it from four to ten times. Chiefly water and certain inorganic constituents are absorbed. In the process of absorption the bile, which is alkaline as it leaves the liver, is slightly acidified. The bile renders the fats and cholesterol soluble at the acid reaction of gall bladder bile. The acutely inflamed gall-bladder mucosa does not concentrate and does not evacuate. Cholesterosis of the gall bladder (strawberry gall bladder) is a condition characterized by lipid deposits in the mucosa of the organ. It does not interfere with the concentrating activity or emptying of the gall bladder unless associated with a moderate or severe cholecystitis.

The gall bladder secretes normally a mucoid fluid. When the gall bladder is acutely inflamed a consider-

able quantity of hmpid sometimes blood tinged, fluid is formed by the mucosa. The ducts secrete a colorless, slightly viscous substance, particularly when obstructed. Common duct obstruction for from twelve to fourteen days with a normal gall bladder in place produces green fluid in the ducts, with the gall bladder out or functionless white fluid. "White bile" or lightly pigmented bile is found and can be produced experimentally under the following conditions: (a) common duct obstruction with a functionless gall bladder, (b) when the liver secretes against pressure in the presence of total obstruction, (c) toxic hepatitis (chloroform and the like), (d) high grade ascending infections or hematogenous hepatitis. In acute febrile diseases such as pneumonia bile output is decreased but a "white bile" is not secreted unless there is an associated hepatitis.

The motor activity of the gall bladder is of two types: first rhythmic tonus changes and second, a tonic contraction of the musculature of the gall bladder as a whole. The power of the normal gall bladder to contract is not greater than the secretory pressure of bile. The chief stimulus of gall bladder contraction thus far discovered is the hormone cholecystokinin. The hormone may be extracted from the duodenal mucosa and, when injected intravenously, causes a more or less prolonged contraction of the gall bladder, with evacuation. The most effective excitants of hormone production are acids and fats acting in the upper part of the intestine. All fats are effective, but egg yolk and cream appear to be the most active.

Whether or not the gall bladder will evacuate when stimulated depends on the tone of the sphincter of Oddi or duodenum or the intramural resistance offered to the flow of bile from the common duct into the lumen of the duodenum. The sphincter of Oddi can resist up to 75 cm. of bile pressure whereas the maximum expulsive pressure of the normal gall bladder is 30 centimeters. A spastic sphincter or duodenum can prevent gall bladder evacuation. The sphincter of Oddi becomes incompetent soon after the removal of the gall bladder, showing that the gall bladder has some functional relation to the sphincter.

Prevention of gall bladder disease may be aided by the daily evacuation of the viscus by appropriate intake of fat. Such prophylaxis should be a part of antepartum care. In acute biliary tract disease foods which excite activity such as fats, meats, and acid fruit juices, should be withheld. Magnesium sulphate or magnesium oxide, atropine or belladonna relax the sphincter. Bile salts only increase the fluid volume of the bile, they have a place in the therapy of chronic but not of acute biliary tract disease.

The evidence is inadequate to warrant the statement that actual damage is done the patient by removing a gall bladder that visualizes and empties. The fact, however, that physiologic and anatomic changes do result following the removal of such a gall bladder should deter the surgeon at least until medical control has been tried.

CHARLES G. SUTHERLAND, M.D.

Gallstones and Their Diagnosis in a Gall Bladder Not Filled by Dye. Emil A. Zimmer. *Röntgenpraxis*, November, 1934, 6, 723-727.

It is sometimes necessary to differentiate shadows caused by gallstones from kidney stones. When the gall bladder is functionless other methods must be used. The gall bladder might be superimposed on the kidney shadow in antero-posterior roentgenograms. A semi-oblique exposure will bring the shadow of kidney stones closer to the spine, the shadow of gallstones farther away from it. A lateral examination might help if the density of the gallstones is sufficient. A gallstone shadow will be more clearly defined on a postero-anterior roentgenogram than on an antero-posterior one. By changing the position of the patient, the position of the stones in the gall bladder might change and the gall bladder itself changes its position, a fact which can be used in questionable cases to advantage.

HANS W. HEFKE, M.D.

GAS GANGRENE

The Importance of Roentgenologic Examination for the Diagnosis and Treatment of Gas Gangrene of an Extremity. Justus Schneider. *Röntgenpraxis*, August, 1934, 6, 522-524.

The gas formation in the soft tissues in cases of gas gangrene can be shown well in roentgenograms. A case is described in which roentgen examinations were used successfully to diagnose the disease to localize the process, and to follow the clinical course of the disease. A recurrence was seen easily on re-examination and checked by surgical incision. It was possible to save the arm of the patient.

HANS W. HEFKE, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

The Unstable or Irritable Duodenum. Clinical Observations in 100 Cases. Julius Friedenwald and Maurice Feldman. *Jour. Am. Med. Assn.*, Dec. 29, 1934, 103, 2007-2011.

The term 'unstable' is preferable since at times a decreased rather than an increased irritability is noted. The underlying cause must be sought in an imbalance in the neuromuscular apparatus of the duodenum leading to a motor dysfunction and possibly also, to a certain degree of a secretory dysfunction without evidence of organic disease. Adhesive processes from chronic cholecystitis, adhesions between the duodenum and hepatic flexure, and those formed as a result of visceroptosis or following abdominal operations or pressure on the duodenum from spinal deformities, ptosis of the right kidney or tumor of the pancreas or other abdominal organs are mentioned as mechanical factors in etiology. Chemical causes are manifested in changes in the gastric secretion, regurgitation of bile and duodenal contents into the stomach due to absorption of toxic material from retained duodenal contents which cause disturbed motility in this portion of the bowel. Allergy has been observed as a definite etiologic factor in certain instances.

Derangement of the nervous system plays an important part in the production of this condition. It frequently arises in high strung individuals, especially during periods of overwork and fatigue. It may be reflex in origin from chronic cholecystitis with or without pericholecystic adhesions, cholelithiasis gastric ulcer, chronic appendicitis and visceroptosis.

The superior portion of the duodenum, also known as the *cap* or *bulb*, is the most frequent site of the manifestation. The irritable bulb is characterized roentgenologically by the presence of (1) an increased motility with complete or incomplete emptying, (2) transient irregularities and fibrillation along the borders, (3) transient spastic manifestations, (4) tenderness and sensitiveness over the duodenum and (5) absence of a definite ulcer filling defect. A series of illustrations diagrammatically outline tracings made from fluoroscopic observations.

Treatment is directed toward a restoration of this part of the bowel to normal tone, which is best accomplished by diet, rest, and improvement of the nervous system. All irritating foods and remedies should be omitted. Psychotherapy plays an important rôle in cases in which neurasthenic manifestations are prominent. In reflex causes treatment must necessarily be directed to the primary disorder.

CHARLES G. SUTHERLAND, M.D.

Polypoid in the Entire Gastrointestinal Tract. C. Gütig and A. Herzog. *Röntgenpraxis*, October, 1934, 6, 671-676.

A case of generalized polyposis in stomach, small intestine, and colon is described, in which the diagnosis was made during the life of the patient by means of roentgenologic examination. While the findings of the roentgen examination correspond with the autopsy as far as stomach and colon were concerned, only a few of the numerous polyps of the small intestines had been shown by the x-ray examination. The reason for it is that the increased and pathologic motility did not allow visualization of all the small intestinal loops. It is, furthermore, very difficult—often impossible—to get satisfactory demonstration of the mucosa relief of the small intestine. A stage preceding the formation of polyps in the small intestine is described which presents itself as an irregular formation of spurs on the ends of the transverse folds.

HANS W. HEFKE, M.D.

The Roentgen Diagnosis of Intermittent Ileus. R. Prévôt. *Röntgenpraxis*, October, 1934, 6, 655-663.

Roentgenologic examination of the small intestines seems, as yet, a more or less neglected field. Berg has pointed out that it is indicated quite often even in acute diseases of the abdomen. An examination during an acute attack has to be done in as short a time as possible, and one must endeavor to make the diagnosis within an hour or two. The first step in such cases should be a fluoroscopic examination of the thorax (for pneumonia, infarct, pleurisy and diseases of the heart), the behavior of the diaphragm should be watched

carefully for evidence of subphrenic processes. The next step is a flat film of the abdomen, after fluoroscopic observation of it, for the possible demonstration of gas-dilated loops of small intestine and gas under the diaphragm. Stones in the urinary tract and gall bladder must be looked for at the same time. A barium enema may be used in all cases of acute diseases of the abdomen, without danger. The administration of barium by mouth, however, might have disastrous consequences by making complete a hitherto incomplete obstruction. All these different methods of examination can be done within an hour.

Roentgenologic examination during an interval when a patient does not present any symptoms may be done much easier and more completely. Cholecystography and urography and complete examination of the gastrointestinal tract may be done. In the case of suspected intermittent small intestinal obstruction, it is of great importance to examine the small intestines at frequent intervals in order not to miss slight dilatation and temporary stoppage in the small intestine. Seven cases are described and the importance of such roentgenologic procedure and diagnosis is emphasized.

HANS W. HEFKE, M.D.

Proteins versus the Carbohydrates. An Inquiry into Their Gastric Digestion. Martin E. Rehfuss. *Jour. Am. Med. Assn.*, Nov. 24, 1934, 103, 1600-1603.

Direct investigation of the behavior of proteins and carbohydrates in the untraumatized normal stomach revealed that the gastric response in all varieties of foods is constant in type in the individual. One was found to be of a relatively slow type and another of a rapid type of gastric digestion. The secretory response could likewise be divided into groups, some showing a tendency to a low secretory output, others a presumed normal, and still others a hypersecretory type of response. In meat digestion alone an evacuation time of from two hours and thirty-five minutes to three hours and twenty-five minutes was noted in different types. The acid figures with meat were the highest of those encountered with any of the varieties of foodstuffs. The normal digestion of carbohydrates is attended by the maceration of the carbohydrate in an acid medium before it is available for further digestion in the bowel. Evacuation time is dependent on the articles ingested and the quantity of food. The average normal individual has a gastric digestion time somewhere near four hours and rarely exceeds five hours, during which no reasonable amount of fermentation can ensue. A falling off in secretion and a slight increase in the evacuation time is evidence of some functional inefficiency on the part of the chronic invalid.

A series of studies showed that even in diseased individuals of markedly different types there is no incompatibility between protein and carbohydrate digestion. There is no evidence either in the literature or in Rehfuss' investigation of such an incompatibility. It is manifest that the danger of such teaching is based on a lack of scientific evidence, and the unqualified acceptance of such a teaching can lead to the occurrence of

able quantity of limpid, sometimes blood tinged, fluid is formed by the mucosa. The ducts secrete a colorless slightly viscous substance, particularly when obstructed. Common duct obstruction for from twelve to fourteen days with a normal gall bladder in place produces green fluid in the ducts, with the gall bladder out or functionless white fluid. "White bile" or lightly pigmented bile is found and can be produced experimentally under the following conditions: (a) common duct obstruction with a functionless gall bladder, (b) when the liver secretes against pressure in the presence of total obstruction, (c) toxic hepatitis (chloroform and the like), (d) high grade ascending infections or hematogenic hepatitis. In acute febrile diseases such as pneumonia, bile output is decreased, but a "white bile" is not secreted unless there is an associated hepatitis.

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HANS W. HEFKE, M.D.

GAS GANGRENE

The Importance of Roentgenologic Examination for the Diagnosis and Treatment of Gas Gangrene of an Extremity. Justus Schneider. *Röntgenpraxis*, August, 1934, 6, 522-524.

The gas formation in the soft tissues in cases of gas gangrene can be shown well in roentgenograms. A case is described in which roentgen examinations were used successfully to diagnose the disease to localize the process and to follow the clinical course of the disease. A recurrence was seen easily on re-examination and checked by surgical incision. It was possible to save the arm of the patient.

HANS W. HEFKE, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

The Unstable or Irritable Duodenum. Clinical Observations in 100 Cases. Julius Friedenwald and Maurice Feldman. *Jour. Am. Med. Assn.* Dec. 29, 1934, 103, 2007-2011.

The term 'unstable' is preferable since at times a decreased rather than an increased irritability is noted. The underlying cause must be sought in an imbalance in the neuro-muscular apparatus of the duodenum, leading to a motor dysfunction and possibly also, to a certain degree of a secretory dysfunction without evidence of organic disease. Adhesive processes from chronic cholecystitis adhesions between the duodenum and hepatic flexure and those formed as a result of visceroptosis or following abdominal operations or pressure on the duodenum from spinal deformities ptosis of the right kidney or tumor of the pancreas or other abdominal organs are mentioned as mechanical factors in etiology. Chemical causes are manifested in changes in the gastric secretion regurgitation of bile and duodenal contents into the stomach due to absorption of toxic material from retained duodenal contents which cause disturbed motility in this portion of the bowel. Allergy has been observed as a definite etiologic factor in certain instances.

dures, were relieved in rather short time by irradiation. Acute lymphadenitis responded very quickly.

In 58 of the 103 cases of inflammatory diseases of the jaws and teeth, the results of roentgen therapy alone were good, in 45 cases the necessary surgery was made possible. There was quite often an acute aggravation of the inflammation from ten to twelve hours after irradiation. From one-eighth to one-twelfth of an erythema dose was given with 160 K V, 4 ma, and a filter of 0.5 mm of copper and 1 mm of aluminum.

HANS W. HEFKE, M.D.

THE KIDNEYS

Treatment of Unilateral Urinary Fistulas by X-ray Destruction of the Kidney. A Clinical and Experimental Study. Nathan P. Sears. *Am Jour Obstet and Gynec*, September, 1934, 28, 402.

The author reviews the literature concerning the effect of x-ray on the kidney, presents a case of urinary fistula cured by irradiation, and reports the result of his experimental work on the effect of irradiation on the kidney of the rabbit. In 1928, Klein successfully irradiated four patients with ureteral fistulas. This was followed by reports by Conrad, Halbfas-Ney, Soiland, and S  n  que, who were likewise successful in the irradiation of urinary fistulas.

The author's patient was a female, aged 49 years, who had suffered with hematuria, pain and frequency for seven years. Roentgenographic examination revealed a shadow in the region of the left kidney. She subsequently developed fever, weakness, and a generalized rash which was diagnosed a toxic dermatitis. Cystoscopic examination revealed a left pyonephrosis. After several irrigations of the left kidney pelvis the rash disappeared and the patient's general condition improved. Following operation, a fistula developed which was treated by irradiation therapy. The anterior and posterior surfaces of the left kidney region were irradiated, employing the following factors: 156 K V P, 4 ma, 0.25 mm Cu and 1 mm Al filter, 20 in distance, two and two-fifths E D divided equally between the two ports.

While the excretion of urine was noted to increase for a short period of time it later diminished in amount. Two months later she received a second series of similar x-ray treatments. Approximately six months later because some drainage from the wound persisted surgical treatment of the fistula was performed. Since the operation failed to produce an improvement in the condition the patient was again irradiated, and three E D were administered. The total irradiation at the surface was seven and four-fifths E D and the estimated dose at the kidney four E D. She was discharged perfectly well and has remained so.

In the author's experiments the right kidneys were removed from six healthy rabbits and after a post-operative period of three months the left kidneys were exposed at operation and irradiated. The factors employed were 106 K V P, 4 ma, 10 in distance, and 1 mm aluminum filter. Two E D were given each rabbit at each exposure. Two animals received 2 E D

two 4 E D, and one, 6 E D. The sixth animal died as a result of air embolism. Approximately four months later, autopsies were performed on the animals. The kidneys were removed and microscopic sections prepared. The kidneys which had received 2 E D showed, in scattered areas, evidence of varying stages of fibrosis and atrophy involving the glomeruli, with occlusion of the capsular spaces. There was also evidence of tubular destruction with fibrosis and considerable round-cell infiltration. Sections of the kidneys which had received 4 E D showed a greater degree of involvement, with marked tubular destruction and subsequent partial regeneration and fibrosis. The glomeruli showed a fibrosis of the capsule, with some slight hyaline change. The surviving convoluted tubules showed varying degrees of degenerative change. There was a diffuse round-cell infiltration. In those kidneys which had received 6 E D there was marked tubular destruction, with subsequent fibrosis. The surviving tubular epithelium showed the same degenerative changes as in the other sections, with scattered areas of apparent compensatory hypertrophy. There was rather diffuse hyaline degeneration of the interstitial tissue, with comparatively slight round-cell infiltration.

The author concludes that it is possible with modern x-ray therapy to destroy normal and diseased kidneys. In general, the epithelial structure of the kidney is replaced by connective tissue as the result of irradiation. The vascular and glomerular units are the last to be affected. The importance of carefully determining the exact location of the kidney so that it will receive all the rays intended for it is stressed by the author.

J. N. AN  , M.D.

KNEE JOINT

Pneumoradiograms of the Knee Joint. J. Oberholzer. *R  ntgenpraxis*, October, 1934, 6, 646-652.

The method of Bircher has become an important diagnostic means to demonstrate the knee joint. It is a combination method inasmuch as neo-skiodan is introduced with oxygen. The neo-skiodan causes a thin shadow on the wall of the capsule, the menisci, the cruciate ligaments and the cartilage. The oxygen causes a negative contrast, and the different parts of the knee joint cavity are nicely demonstrated in this way. Several cases are described and many roentgenograms are reproduced to prove the diagnostic value of the procedure. Strictly aseptic and correct technique is necessary for pneumoradiograms. This special technique allows a much more exact diagnosis of the knee joint than does the plain roentgenogram, especially in pathologic conditions of the joint capsule, ligaments, menisci, and cartilage.

HANS W. HEFKE, M.D.

THE LUNGS

Lung Abscess. Harold Brunn. *Jour Am Med Assn*, Dec 29, 1934, 103:1999-2003.

The scope of this paper is limited to that type which has its beginning as an acute putrid abscess—foul

serious malnutrition as well as to a lighting up of tuberculosis and old infections

CHARLES G. SUTHERLAND, M.D.

GENITO-URINARY TRACT (DIAGNOSIS)

Postpartum Pyelitis of Pregnancy Treatment of Certain Cases without the Use of the Ureteral Catheter Explanation Based on Physiology of the Bladder D. K. Rose Am Jour Surg, September, 1934, 25, 394-397

In postpartum pyelonephritis, with bladder retention in which catheter interference is indicated either from dysuria or toxicity, we meet with two entirely opposite types of bladder function. Either may exist separately or the two may co exist to any degree.

The postpartum bladder showing a relatively fixed compensated bladder wall back of a physiologic block motor and sensory, of the external sphincter, if of sufficient degree requires continuous drainage when indicated by reason of infection. Such drainage primarily reduces bladder infection and secondarily, urethral pelvic, and kidney infection by facilitating ureteral flow through a decompressed and perfectly drained bladder. Intermittent catheterization in such a bladder traumatizes in the presence of imperfect drainage and therefore, tends to generalize or diffuse the infection. Irritative instillations in such bladders are contra indicated. Ureteral catheter drainage is indicated only when a primary ureteral block such as stone stricture etc. exists to complicate the usual clinical picture.

If sufficient degree of altered bladder function occurs continuous bladder drainage is indicated until perfect function is restored.

The post operative bladder with inhibited or functionally weakened bladder wall and with normal sphincter tone requires only intermittent catheterizations. Frequently, one to three will suffice to restore normal function. If not the inhibition reflex is continued from the operative site. Irritating instillations in these bladders may be of value. Other post-operative types of retention are psychic or protective permitting the bladder to over distend.

DAVIS H. PARDOLL, M.D.

GRENZ RAYS

Biologic Experiments with Grenz Rays F. Koch Strahlentherapie 1934 51, 541

The author undertook extensive experiments with Grenz rays and studied the reactions on the skin which he found cannot be used for dosage. Studies of the effect of Grenz rays on *lens esculenta* proved to be very suitable for a biologic dosimetry. The maximum dose determined in these experiments agreed well with clinical experience. The mitosis curve following the application of heavy doses of Grenz rays showed a different slope than the curves obtained following radium and x ray exposure. It was interesting to note that the biologic effect of Grenz rays increased with decreasing wave length.

ERNST A. POHLE, M.D., Ph.D.

HEMOPHILIA

Bone and Joint Changes in Hemophilia Leon Solis Cohen and Samuel Levine Am Jour Roentgenol and Rad Ther April 1934 31, 487-491

Hemophiliacs who reach the age of puberty often develop bone and joint lesions. Pathologically there are three stages. First, hemorrhage into the joint, with thickening of the fibrous joint capsule. Second, vacuolization in the epiphysis above the articulating surface, with the edges of the latter sharply etched and well defined and opposing joint surfaces separated by a hemorrhagic effusion. Third, the regressive phase the loss by destruction or absorption of cartilage resulting in deformity and pseudo-lipping.

Roentgenologically, the diagnostic signs are as follows:

Acute or first stage—Joint space widened and denser.

Second stage—Thickening of the joint capsule and often a crater like excavation in the extra articular portion of the diaphysis. Shadows of an organized blood clot are found in the recesses of the joint and follow the outline of the joint capsule. The density of the synovial tissue may resemble the calcifications observed in myositis ossificans. Widened joint spaces occur without bony ankylosis. In the knee the femoral condyles may be broadened.

Third or regressive stage—The articular surfaces are irregular and the ends of the bones entering the joint may be deformed. Pseudo-osteophytes due to the hollowing out of the extra articular surfaces of the articulating bones are observed. In the knee, the spine of the tibia is often deformed and the intra condylar notch widened. In the elbow, subperiosteal hemorrhage may undergo calcification. In the hip the bone changes may resemble Perthes' disease. In the shoulder the changes may simulate caries sicca.

S. M. ATKINS, M.D.

INFLAMMATORY DISEASES

Roentgen Therapy in Acute Inflammatory Diseases of the Mouth R. K. Kruglikowa and S. N. Weissblatt Röntgenpraxis August, 1934 6, 527-530

X ray therapy is used extensively in many inflammatory diseases but its use in inflammatory processes of the mouth and teeth has been neglected. The results in 103 cases are reported. In 66 patients with acute diffuse or localized osteomyelitis of the jaws roentgen therapy alone led to a cure in 23 and improved the condition in the others so much that surgical procedures could be instituted much earlier than usual. In some very septic and almost hopeless cases this treatment led to improvement. Soft tissue phlegmons due to an osteomyelitis of the jaw responded well to x ray therapy the results appeared to be better than with the other conservative measures. Difficult eruption of the third molars with infected pockets which caused considerable pain was markedly improved by roentgen treatments and the duration of the symptoms was much shortened as compared with the older methods. Neuralgias after local anesthesia and surgical proce-

Primary carcinoma of the lung or bronchial carcinoma in the hilar regions may cause the x-ray appearance of a well-circumscribed round shadow when seen at an early stage usually, however, such a tumor shows irregular lymphangitic extension or causes symptoms of atelectasis and secondary infection. Almost all metastatic lung tumors show the round type of shadow, especially the sarcomas. Benign tumors—for instance, dermoids—may present the same picture as malignant tumors. Echinococcus cysts cause the roentgen appearance of single or multiple round shadows, only the clinical symptoms and sometimes the Escudero-Nemenow symptom of change of the shape of the shadow in inspiration and expiration must decide the diagnosis.

Actinomycosis and syphilis are known to have shown regular round areas of infiltration in the lungs.

Tuberculosis of the lungs occasionally may make considerable difficulties in differentiating it, roentgenologically, from tumors, when it appears in well-circumscribed round or oval shape in roentgenograms. The infiltrations may be even multiple. Roentgenologic follow up and other clinical symptoms must help to make the diagnosis.

Round shadows have been seen as the expression of bronchopneumonia, even multiple. Especially the influenza-pneumonias seem to show this atypical appearance. Three cases of puerperal septic pneumonias have been seen to cause round, fairly circumscribed areas of density in roentgenograms of the lungs.

It becomes more and more evident that the well-defined round shadows seen in lung roentgenograms are by no means always caused by malignant tumors, one must consider many other diseases, and history and clinical examination are often necessary for a correct diagnosis.

HANS W HEFKE, M D

The Bronchopulmonary Segment, with Special Reference to Putrid Lung Abscess. Ameil Glass. *Am Jour Roentgenol and Rad Ther* March 1934, 31, 328-332.

Clinical, operative, and autopsy studies at Mt Sinai Hospital (New York) have demonstrated that putrid lung abscess in its primary evolution involves definite and circumscribed regions of the lungs. These are subdivisions of lobes and possess constantly a definite size, shape and position. These have been designated bronchopulmonary segments and act as the unit of localization in lung abscess. Each is named according to the position in the thoracic cage and pulmonary architecture.

On the postero-anterior view, roentgenologically, abscess in the inner lung field represents disease of the posterior segments, lateral field of the axillary segments and middle field either anterior or posterior and a lateral view is necessary. The exception is the abscess adjacent to the heart and situated on the diaphragmatic dome, this lies in the mesial segment.

S M ATKINS M D

THE MASTOIDS

The Roentgenologic Diagnosis of Mastoiditis. Leonard Kraus. *Röntgenpraxis*, August, 1934, 6, 497-503.

A roentgenogram of the mastoids is necessary for a complete examination of the ears. The author reports his findings in a special group of mastoid cells, which he calls 'hypolabyrinthine cells'. Anatomically they are situated below the antrum toward the tip of the mastoid and just below the horizontal and posterior semicircular canal, extending toward the medial end of the petrous bone. Because they are in close proximity to the sigmoid sinus and the seventh nerve they may lead to serious complications if they are not recognized and opened by the surgeon. The clinical symptoms of involvement of this cell group are dull unilateral headache and vertigo, sometimes without tenderness over the mastoid. These cells are occasionally the only ones involved while all other cells remain normal. Often there are other abscesses usually in the tip. The hypolabyrinthine cells can almost always be found on roentgenograms, when the other cells are well developed. The absence of aeration of these cells as compared with the normal side indicates pathology. A roentgenologic examination of the mastoids is not complete without paying attention to this group of cells, and findings in them might be of great importance to the surgeon.

HANS W HEFKE, M D

PEPTIC ULCER (DIAGNOSIS)

Complications of Peptic Ulcer. Their Prognostic Significance. Sara M. Jordan and Everett D. Kiefer. *Jour Am Med Assn*, Dec 29, 1934, 103, 2004, 2005.

Successful management, the purpose of which is to produce a remission and prevent a recurrence, must be the thought rather than cure, in handling this disease. This depends on various intrinsic and extrinsic factors. Such well-known factors as limitation of nervous tension and fatigue and adherence to a careful regimen of living are at least relatively within the control of the patient and the physician. The intrinsic factors comprise (1) the nature of peptic ulcer in general and (2) the nature of the individual ulcer, particularly its location, size, and complications. The complications considered in the authors' study are pyloric obstruction, hemorrhage and intolerance to alkaline therapy. Of 79 cases, only 11 per cent required surgery for the immediate relief of obstruction. Relief was obtained in 89 per cent by hospital management of from one to three weeks' duration. In 34 per cent of patients relieved by medical management there were recurrences—in nine obstruction and in fifteen distress alone or with hemorrhage. The tendency to recurrence in a given group was just as great at the end of five years as it was during the previous years. In a group of 42 patients giving a history of one gross hemorrhage, 17 per cent had recurrence during the first year, during the first five years, 43 per cent experienced a recurrence and 57 per cent had an uninterrupted remission. The his-

smelling, containing elastic tissue, usually aspiratory in origin, and containing a multiplicity of bacteria, both anaerobic and aerobic, excluding bronchiectasis, abscesses on a carcinoma basis, and those produced by foreign bodies. Under the term of "medical treatment" the author has included inhalations, postural drainage, bronchoscopy, artificial pneumothorax, phrenicectomy, arsphenamine and the application of roentgen therapy. Surgical treatment includes only open drainage and lobectomy. The advantages of postural drainage are not nearly so great in abscess as in bronchiectasis. It is valueless until an abscess has broken into a bronchus. To apply this remedy to a very sick patient—cyanotic, with high fever, rapid pulse, and a low vital capacity—is to court disaster. Pulmonary ventilation is facilitated in the upright position, vital capacity is generally higher, and the volume of the lung is greater; the accessory muscles of respiration can be used to better advantage, and the diaphragm is lower than in the recumbent position. Intrapleural pressure has been found less negative in the recumbent than in the upright position. A less negative intrapleural pressure will limit pulmonary ventilation and interfere with pulmonary circulation. All these factors work an even greater disadvantage in the position of postural drainage—produce compression and atelectasis of the lung and so lower its resistance that infection may take place, with intrapulmonary spread.

Bronchoscopy is useful for the purpose of eliminating the possibility of a foreign body for the diagnosis of a malignant condition or stenosis as a cause of the abscess and for the purpose of shrinking granulations to permit of better drainage through the bronchus, but the procedure cannot be carried out with sufficient frequency on a sick patient to really keep an abscess drained surgically. It is not entirely devoid of the danger of setting up further inflammation.

Artificial pneumothorax in the author's experience has risks that do not justify its use. It is applicable to but few; it tends to break down adhesions and not infrequently causes rupture into the pleural cavity, with formation of a putrid empyema and entails delay just when surgery would be beneficial.

Temporary phrenic paralysis is best applied for abscess of the lower lobe with adhesions to the diaphragm but has very limited application. Arsphenamine as a cure has been unsatisfactory in Brunn's experience.

Roentgen therapy, to cause more rapid liquefaction of the abscess, early rupture into a bronchus, clearing up of surrounding pneumonitis, and delimitation of the disease is probably advantageous and may prove a most valuable adjuvant but experience does not yet warrant a definite conclusion as to its value.

Roentgenograms should be taken in various planes and with varying densities and should be used frequently to follow the course of the disease. They should not be relied on absolutely; in some cases the clinical course offers a better basis of judgment. The use of iodized oil seldom gives any information in lung abscess.

Surgery offers definite advantages in the treatment of lung abscess. Perfect drainage of the abscess cavity can be obtained, leaving no undrained pockets from which extension can take place. Through and through aeration of the cavity and bronchi results. By a liberal removal of the roof of the cavity, its early collapse is facilitated. Certain important requisites are mentioned: (1) careful localization, (2) the performance of the operation in two or even more stages, (3) the use of the cautery or diathermy knife in exposing the abscess, and (4) the use of compression by a gauze pack or paraffin.

A study of charts and tables based on medical and surgical treatment shows definitely the advantages of positive action in the treatment of lung abscess.

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The changes of the bronchial tree in lung abscess depend on the stage of development of the process. In the pre-expulsive phase of the acute period, the bronchographic picture is normal but alveolar dispersion is missing because the 40 per cent iodipin cannot fill the alveoli which are already filled by exudate.

The bronchographic appearance is different in the phase of abscess formation. The cavity usually does not fill. The bronchial tree may look normal even though the alveolar dispersion is absent or there may be a cylindrical or pearl string like dilatation of the draining bronchus.

If one is not dealing with a basal abscess, the bronchi of the base may also be dilated, which may be explained by the fact that the secretion of the cavity drops into the basal bronchi, continuously reinfecting them in this way. In one type of acute abscess, the pathologic changes are found simultaneously in the parenchyma and in the bronchi which dilate prematurely and present the picture of cylindrical dilatation.

During the chronic stage the abscess cavity usually may be filled by the contrast material, and the surrounding bronchi show saccular dilatation. The draining bronchi show either cylindrical or pearl string like dilatation and the basal bronchi also may show this type of bronchiectasis.

If the cavity is not visible it is difficult and sometimes impossible to differentiate between massive bronchiectasis and an abscess leading to a bronchiectasis. Occasionally one can find in the bronchogram an abscess cavity of fair size and surrounding it several smaller cavities of saccular appearance which are to be explained by bronchiectatic dilatation.

HANS W. HEFKE, M.D.

Round Shadows in the Lungs. Ladislaus Udvary. *Röntgenpraxis*, November 1934, 6, 713-723.

Round, well-circumscribed shadows in lung roentgenograms are considered usually as typical for tumors, in publications of the last few years however many other causes have been described.

Primary carcinoma of the lung or bronchial carcinoma in the hilar regions may cause the x-ray appearance of a well-circumscribed round shadow when seen at an early stage usually, however, such a tumor shows irregular lymphangitic extension or causes symptoms of atelectasis and secondary infection Almost all metastatic lung tumors show the round type of shadow, especially the sarcomas Benign tumors—for instance, dermoids—may present the same picture as malignant tumors Echinococcus cysts cause the roentgen appearance of single or multiple round shadows, only the clinical symptoms and sometimes the Escudero-Nemenow symptom of change of the shape of the shadow in inspiration and expiration must decide the diagnosis

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'Peremesin' (Heyden), a colloidal cerium preparation, which is claimed to be non toxic and harmless, was used by the author in 60 cases for the prevention of x ray sickness. While, previously, many patients complained of sickness such complaints have not been heard since administering the drug. Two tablets were taken before, and four tablets in intervals after, the irradiation.

HANS W HEFKE, M D

THE STOMACH

Multiple Diverticula in the Cardiac End of the Stomach. Kurt Kremser. *Röntgenpraxis*, August, 1934, 6: 524-527.

A single diverticulum of the stomach has been reported but is rare. In the patient seen by the author, four small diverticula were demonstrated in the cardiac end of the stomach. The barium remained in one of them for three hours. The author believes that the diverticula were congenital.

HANS W HEFKE, M D

The Diagnosis of Lymphosarcoma of the Stomach. O Spitzberger. *Röntgenpraxis*, October, 1934, 6: 667-670.

Lymphosarcomas of the stomach are relatively rare tumors and usually the roentgenologic diagnosis is impossible to make. There seem to be a few facts which might point to lymphosarcoma, considering differential diagnosis from carcinoma: first, its localization on the greater curvature side of the fundus, second, the involvement of the diaphragm by direct extension, and furthermore clinically the very marked loss of weight in a very short time and the severe gastric pain. This differentiation is of some importance because lymphosarcomas may be benefited by roentgen therapy. One case is described in which a large lymphosarcoma of the fundus was diagnosed roentgenologically, was treated by x rays, and received much benefit by these treatments.

HANS W HEFKE, M D

Benign Tumors of the Stomach. Martin Simonsen. *Röntgenpraxis*, October, 1934, 6: 663-666.

The roentgenologic characteristics of benign tumors of the stomach are well known (smooth borders, round or oval filling defects, mobility of the tumor by the palpating hand, absence of changes in the mucosa surrounding the defects, undisturbed peristalsis). Three cases are reported: first, a fairly movable benign tumor of the pylorus; second, an adenomatous polyp on the greater curvature, which was found to show early malignant changes at autopsy; and third, a malignant polyp of the antrum which could have been mistaken for a benign tumor. It is pointed out that the question of the benign or malignant nature of a circumscribed gastric tumor cannot be determined by roentgen examination alone. Other clinical symptoms, especially the sedimentation time, must be considered, and even then a correct diagnosis can be made, frequently only by microscopic examination of the tissue after surgical removal.

HANS W HEFKE, M D

TUBERCULOSIS, INTESTINAL

Intestinal Tuberculosis. Pathologic and Roentgenologic Observations. Russell L. Boles and Jacob Gershon Cohen. *Jour Am Med Assn*, Dec 15, 1934, 103: 1841-1845.

Clinically, the diagnosis is seldom made with any degree of certainty although it is presumed to exist in many cases. Numerous pathologic studies show a consistently high incidence of intestinal tuberculosis associated with pulmonary tuberculosis, the incidence varying from 50 to 90 per cent. Analysis of autopsies studied was undertaken in order to determine (1) if tuberculosis of the intestine, whether hyperplastic or ulcerative, occurred more frequently than is suspected in the absence of pulmonary tuberculosis, (2) its incidence and relation to the type of pulmonary tuberculosis, and (3) the incidence of associated tuberculous disease of other abdominal viscera.

Of 1,000 autopsies studied, tuberculosis of the lungs was found in 226 cases (23 per cent). No evidence of it was found in 774 cases. In the entire 774 negative pulmonary cases no evidence of tuberculosis of the intestine, either hyperplastic or ulcerative, was found. In the 226 cases of healed and active pulmonary tuberculosis, an ulcerative type of intestinal lesion occurred in 63 (28 per cent). Primary hyperplastic tuberculosis or tuberculoma of the large bowel was not observed in the 1,000 autopsies, and it must be regarded therefore, as a most infrequent variety of intestinal tuberculosis in adults. It may be more common in children, very few of whom were included in this study.

Of the 226 cases of pulmonary tuberculosis, the type and incidence of lung lesions were as follows: fibro-ulcerative cavernous, 105 cases (46 per cent), chronic fibroid, 85 (38 per cent), exudative, 22 (10 per cent), miliary, 12 (5 per cent), and tuberculous pneumonia, 2 (1 per cent).

Intestinal ulceration does not occur in the healed fibroid cases. The highest incidence of intestinal ulceration was observed in the fibro-ulcerative cavernous type, the next highest in the exudative pulmonary lesion. In 12 miliary cases of pulmonary tuberculosis, intestinal ulceration was not seen in a single case, a miliary lesion of the serosa was not infrequently noted. The authors' findings would appear to support the contention that intestinal mucosal lesions are caused by swallowed tubercle bacilli or enterogenous infection and that intestinal serosal lesions are probably due to blood-borne tubercle bacilli or hematogenous infection. Primary hyperplastic tuberculosis or tuberculoma of the bowel rarely occurs, whereas carcinoma, which it may simulate, is not unusual in the tuberculous subject.

As an important aid in the diagnosis of ileocecal tuberculosis, the authors recommend the double contrast enema. It reveals the indirect signs as segmental irritability and hypermotility and, in addition, provides an accurate demonstration of the actual morbid anatomic changes of the diseased segments of the bowel.

CHARLES G SUTHERLAND, M D

tory of two or more gross hemorrhages was decidedly more serious. In a group of 10 patients only 21 per cent remained free from recurrence for five years. In another group of 13 cases 54 per cent had recurrence in a two year period. The prognosis of patients with multiple hemorrhages appeared to be definitely bad.

Alkalosis from alkali medication was a complication of therapy arising when efforts were made to neutralize the stomach contents with sodium bicarbonate. In nearly all cases the condition was mild and transient and easily relieved by adjusting the dose. Severe alkalosis indicated a particularly severe lesion and a marked disturbance in gastric secretion as well as renal disease. 70 per cent had a recurrence within two years.

CHARLES G. SUTHERLAND, M.D.

PLEURISY, MEDIASTINAL

Mediastinal Pleurisy. Ladislaus Udvady, *Röntgenpraxis* September, 1934, 6, 585-593.

Comparatively little has been written about mediastinal pleurisy and yet the clinical and roentgenologic appearance of it is very definite. Tuberculosis is the most common etiologic cause, probably due to the caseation of mediastinal glands. In such cases the hilus itself is dense, and one sees a shadow of increased density beside the mediastinum, wider in the upper portions. If one makes a radiogram of a chest in Fleischner's position (lordosis of the lumbar spine), one may see a much larger more intensive usually triangular shadow which represents the thickened pulmonary and mediastinal pleura and the thickened interlobar space filled by exudate.

Tumors especially of the hilus glands, lung abscesses and abscesses originating in the vertebrae also may be causative agents.

Of more importance and more interest are cases in which simple pleurisy is the etiologic factor. Clinical history in such cases is often indefinite. The patient complains of pleural pain, high fever, and severe cough the latter often spasmodic. Such mediastinal exudates have a triangular shape with the base toward the lower portions. Again Fleischner's position is of help.

Mediastinal pleurisy in the inferior mediastinum is much harder to diagnose and roentgen examination alone is not sufficient usually for diagnosis. Several such cases are described and it is pointed out that a pericardial effusion easily may be mistaken for it. Fluoroscopic examination seems to be much more important for mediastinal pleurisy than films. If films are taken, they are best taken with the Bucky diaphragm.

HANS W. HEFKE, M.D.

THE PROSTATE

A Case of Sarcoma of the Prostate Cured by Roentgen Therapy. L. Popp, *Röntgenpraxis* October 1934, 6, 680-681.

Early carcinoma of the prostate gland should be operated on. Post-operative irradiation with large fields

and high voltage should be used on account of the frequency of early metastasis. In inoperable cases the trial of roentgen or radium therapy is permissible, but the results are not encouraging. Pain caused by bone metastasis often may be relieved by x-ray therapy.

Sarcomas of the prostate gland are seen much less frequently. Histologically, they are lympho- or adenocarcinomas. The treatment should be surgical removal and post-operative radiation. Lymphosarcomas are so radiosensitive that roentgen therapy alone is sufficient. The case is reported of a 24-year-old man who had an inoperable sarcoma of the prostate. After repeated series of x-ray treatment the tumor disappeared and the patient was well two years after the treatments.

HANS W. HEFKE, M.D.

RADIATION EFFECTS

The Fibrinogen Content of the Blood under the Influence of Roentgen Irradiation and the Primary Effect of Radiation. A. Held and H. Hülbach, *Strahlen therapie* 1934, 51, 664.

It has been known that the coagulation time of the blood has decreased following exposure to roentgen rays. The authors found in their experiments that this is probably due to an increase of the fibrinogen. The reticulo-endothelial system is undoubtedly involved in the reaction. The drop in the fibrinogen content of the blood which follows immediately after the exposure to roentgen rays is explained as a direct effect of radiation.

ERNST A. POHLE, M.D., Ph.D.

Epilation of Rabbit Skin following Irradiation. G. H. Klövekorn, *Strahlentherapie* 1934, 51, 689.

The author studied the epilation in the skin of rabbits following exposure to roentgen rays. He comes to the conclusion that rabbit skin is not a suitable object for biologic studies of epilation. He found that it occurs in the rabbit between 840 and 2,100 r anywhere from 18 to 35 days following exposure. He also briefly reports the histologic changes found in the skin following irradiation.

ERNST A. POHLE, M.D., Ph.D.

RADIUM

Radium Therapy in Malignant Tumors of the Upper Respiratory Tract. Results Based on Five Years Observations. A. Lang, *Strahlentherapie* 1934, 51, 573.

The author presents an analysis of 59 cases with malignant tumors in the nose, epiglottis, meso- and hypopharynx. They were treated by x-rays and radium either alone or combined. The results are compiled in seven tables and should be studied in the original. The author removes the lymph glands if there is no evidence of involvement; all others are subjected to irradiation.

ERNST A. POHLE, M.D., Ph.D.

ROENTGEN SICKNESS

Peremesin for the Prevention of X-ray Sickness. Hermann Kuhn, *Röntgenpraxis* September 1934, 6, 615-616.

with multiple small foci, usually symmetrically distributed throughout both lungs. The reasons for assuming a hematogenous spread are (1) Even distribution of the lesions, (2) frequent absence of older pulmonary foci, (3) frequent association of extrapulmonary lesions.

Röntgenologic Characteristics—Early lesions appear as scattered fluffy areas of increased density with blurred borders fairly homogeneous, and varying in size. The distribution may be almost as regular and dense as in acute miliary tuberculosis or the lesions may be confined to the upper thirds of the lungs, especially in children. In the early stage, it occurs in two different aspects: (1) Small, fairly evenly distributed foci of slight density are seen, up to two or three millimeters in diameter. Individual foci, in contradistinction to miliary tuberculosis, show soft stringy lines between the more globular shadows. (2) The single lesions about one to two centimeters in diameter have borders ill-defined. Both types usually show enlargement and possible caseation of hilar lymph nodes. Most frequently the upper third or half of both lungs is affected.

The further roentgenologic development of these foci occurs along varying but characteristic lines. There may be complete resorption or calcification. The latter is usually initiated by soft circumfocal shadows. Differing from true primary foci, calcification occurs only in this type of tuberculosis. Another characteristic is in addition to the calcification, that the stringy elements become a thin but dense network of sharp lines. Another development is bronchogenic pthitosis. The clinical course differs from bronchogenic tuberculosis in that frequently there is total absence of symptoms. There is very little sputum and only rarely is sputum positive. Pathologically the major part of the involvement is in the interstitial tissue.

S M ATKINS M D

TUMORS (DIAGNOSIS)

Roentgen Diagnosis of Mediastinal Tumors and Their Differentiation George E Pfahler. *Am Jour Roentgenol and Rad Ther* April 1934 31, 458-469.

This is a study based upon a review of 219 cases diagnosed as tumors. In their study a number of factors must be determined: (1) size, (2) shape, (3) location, (4) relation, (5) pulsation, (6) movement. All methods of radiologic examination must be employed if necessary.

Substernal thyroid, enlarged thymus, dermoid cysts, diverticulum of the pericardium, lipoma, fibroma, neuroma, aneurysm, lymphosarcoma, Hodgkin's disease, leukemic lymphoma, leukosarcomatosis, primary carcinoma, metastatic carcinoma, tuberculous lymphoma, syphilis, actinomycosis, and mycosis fungoides are thoroughly reviewed and illustrative cases cited.

S M ATKINS M D

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Roentgen Therapy of Bone Sarcoma K Gold-

The author reports a case of a man, 53 years of age, who on roentgen examination showed a large-sized tumor in the right humerus. Because of the destructive nature of the process the diagnosis of a sarcoma was made. Heavy doses of roentgen rays were applied over a period of two years; the tumor responded well and roentgenograms are shown in the article taken at certain intervals during that period. The author feels that the tumor is in all probability a round-cell sarcoma. No biopsy.

ERNST A POHLE, M D, Ph D

Studies in the Diagnosis and Treatment of Teratoma Testis Russell S Ferguson. *Am Jour Roentgenol and Rad Ther*, March 1934, 31, 356-365.

The diagnosis of this condition is rarely made. Only 11 cases among 124 seen at the Memorial Hospital (New York) were free from local recurrence or metastasis, although 20 per cent of these patients sought medical advice within the first six months of the disease. This tumor constitutes 2.09 per cent of all malignant tumors in males and 3.39 per cent of all genito-urinary tumors.

There are no distinctive clinical features, even therapeutic test of radiation fails. It is best to delay operation until the diagnosis is accurately established. Of 59 new admissions from October, 1930, to October, 1932, the diagnosis was verified by histologic examinations in every case. All have had quantitative study of Prolan A in the urine.

This paper is a study of the relation of the biologic behavior of this tumor to radiosensitivity and to the pathologic anatomy of the disease as well as the efficacy of different types of treatment. It is shown that the best results are from the study of the biologic behavior before, during, and after irradiation.

Relation of Radiosensitivity to Excretion of Prolan A—Of 13 patients having tumors of the radioresistant type following irradiation, five are alive without disease from one to three years, and eight dead. In those who died, there was no decrease or only temporary decrease of Prolan A. In those alive, Prolan A dropped sharply. Of 22 patients having tumors of the radio-sensitive type, thirteen are alive one to three years, and nine dead. In those alive, Prolan A dropped promptly to below 400 mouse units per liter of urine within two weeks after the termination of irradiation. With recurrence the Prolan A increased and was lowered again by irradiation. Those patients who died showed no decrease in the Prolan A.

Prognosis based on histologic structure was not dependable, for about 50 per cent of the radioresistant survived and about 50 per cent of the radiosensitive succumbed. Pathogenesis and pathologic anatomy as basis for selection of therapy show the rationale of radical surgery to be entirely discredited. Only 6 per cent of teratoma testis tumors are of the adult type. These run a prolonged clinical course and metastasize late. Embryonal carcinoma is active and metastasizes rapidly to lymphatic system.

TUBERCULOSIS, PULMONARY

The Effect of Initial Tuberculous Infection on Subsequent Tuberculous Lesions J Arthur Myers and Francis C Harrington Jour Am Med Assn, Nov 17, 1934, 103, 1530-1535

Tuberculous lesions which develop in tissues that are not sensitive to tuberculoprotein are designated as primary lesions, first infection type of lesions or, if in the lung childhood type of tuberculosis. The diagnosis of the first infection type of tuberculosis is made primarily by the tuberculin test. The roentgenogram plays a minor rôle, while symptoms and physical signs are of little value. The reinfection type of tuberculosis develops on tissue that is sensitive to tuberculoprotein. In nature so far as is known such sensitiveness is produced in the human tissues only by a first infection type of tuberculosis. Reinfection foci may be divided into two groups acute and chronic. The best examples of acute reinfection types are miliary disease and diffuse meningitis. Good examples of the chronic form of reinfection type of tuberculosis are disease of the bones, joints, and lungs. Here the roentgenogram is the most valuable diagnostic agent. Although this type of tuberculosis may be present in the lung a long time before it is sufficiently large to cast a shadow on the x ray film, it will be detected by this method of examination earlier than by any other.

The authors do not make roentgenograms of the chest in children under ten years of age, even of the children who react positively unless there is some special indication. The cost is too great to justify the small findings. The period of greatest danger, during which roentgenograms should be made periodically begins about the age of ten or eleven years. After that age roentgenograms should be made periodically of the chests of all positive reactors.

CHARLES G SUTHERLAND, M D

Bronchography, an Essential and Safe Adjunct in the Study of Pulmonary Tuberculosis J E Murphy Am Jour Roentgenol and Rad Ther, March 1934 31, 301-307

Bronchography is essential in the following

1 Interpretation of pathology of tuberculosis—(a) demonstration of bronchiectasis which so frequently accompanies it—60 per cent of 85 cases, (b) solution of baffling areas into clear pathology

2 In the differentiation of parenchymal cavities from bronchial dilatation, and in cases in which selective collapse is to be practised it localizes both the lobe and cavity

3 Clinical explanation of a productive cough with negative sputum

The limitations are

(1) The solution may not enter into a cavity due to disease and secretions

(2) Slight dilatation may be due only to the inspiratory phase and may be normal in the expiratory phase

The contra indications are

- 1 Acute tuberculosis accompanied by fever
- 2 Debility,
- 3 Recent hemorrhage in which case it is best to wait ten days

Technic—The intratracheal route is employed with the catheter introduced intranasally, under local anesthesia. Injection is made with roentgenoscopic control.

Numerous films are shown illustrating the conditions
S M ATKINS M D

Bronchography in Relation to the Pathology of Pulmonary Tuberculosis B P Potter Am Jour Roentgenol and Rad Ther, March 1934 31, 308-318

The following problems of pathology are clarified

1 Bronchiectasis in tuberculosis is demonstrated in a high percentage in the chronic fibro ulcerative lesions.

2 Annular shadows are differentiated into cavities pleural pockets, encapsulated pneumothoraces, and emphysematous blebs

3 Localization of the pathology in the particular lobe or lobes involved is accomplished

4 Differentiation between pleural and parenchymal pathology is made, especially when the lung is obscured by pleural changes

5 Differentiation between densities cast by un-aerated lung and similar densities due to other causes is established

Numerous films are shown illustrating the conditions

S M ATKINS M D

Round Foci Type of Pulmonary Tuberculosis Samuel Bruck Am Jour Roentgenol and Rad Ther, March, 1934, 31, 319-322

A case is cited wherein a few sharply circumscribed shadows resembling metastatic malignancy were seen in the lungs and which were proven to be tuberculosis. These by themselves as proven by similar cases reported (but few in the literature) present usually no clinical symptoms and usually do not break down or disappear although in the case reported these did happen. They may or may not be accompanied by the usual roentgen manifestations of tuberculosis.

Pathologically the lesions appear as rounded parenchymatous consolidations surrounded by a capsule of fibrous tissue without any surrounding tissue reaction. They are not primary lesions of tuberculosis in that there is no accompanying adenopathy and so few of these cases are seen. This type of tuberculosis is to be kept in mind when findings resembling metastatic malignancy are seen in the lungs but in which no primary lesion can be demonstrated.

S M ATKINS M D

Hematogenous (Non miliary) Pulmonary Tuberculosis Max Pinner Am Jour Roentgenol and Rad Ther, April 1934 31, 442-457

This is a report based on 28 cases 14 of which came to autopsy. Roentgenologically the disease starts

with multiple small foci, usually symmetrically distributed throughout both lungs. The reasons for assuming a hematogenous spread are (1) Even distribution of the lesions, (2) frequent absence of older pulmonary foci, (3) frequent association of extra-pulmonary lesions.

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ERNST A POHLE, M D, Ph D

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Treatment—That there is no justification for either simple orchiectomy or radical operation is shown by the most recent statistics of Hinman or review of Wasterlain, on the basis of clinical results at the end of five years

Irradiation—In 154 cases (at Memorial Hospital), Dean reports 20.2 per cent alive and without evidence of disease at the end of five years of which 74.6 per cent were inoperable on admission. Of 100 patients who had radical operation, as reported by Hinman, 17 are alive and without evidence of disease after five years. Irradiation results have improved since the quantitative study of Prolan A in the urine for by this means, recurrence is easily detected

S M ATKINS M D

THE UTERUS

The Treatment of Erosions of the Uterus with Roentgen and Radium Rays. A J Kuratschenkow. *Strahlentherapie* 1934 51, 622

Since the erosion of the cervix is often a forerunner of carcinoma, adequate treatment should be instituted in the early stages. Good results have been obtained by both radium and x ray treatment. 480 to 2000 mg-hr usually suffice. Roentgen technic 110 KV, 3 mm Al 75 r or 165 KV 0.5 Zn + 3 Al, 250 r. If the lesion responds it results in a solid scar which usually does not develop a recurrence, and there seems to be no danger of malignant degeneration.

ERNST A POHLE M D, Ph D

Results in the Treatment of Carcinoma of the Cervix by the Women's Clinic of the University of Breslau. W Reiprich. *Strahlentherapie* 1934 51, 601

The author analyzes the statistics giving the results obtained in the surgical and radiological treatment of carcinoma of the uterus seen in his own clinic. Radiation therapy consists usually of a combined x ray and radium treatment. The total radium dose in the average case is 5000 milligram hours. In roentgen therapy the customary deep therapy technic is used with one anterior two posterior, and one perineal field. The total dose effective at the site of the disease amounts to from 110 to 120 per cent HED. Tables are also given permitting a comparison with the results obtained by other leading clinics. The author comes to the conclusion that the best results are to be expected in operable cases from a combination of surgery and irradiation.

ERNST A POHLE M D Ph D

THE WRIST

Hereditary Synostoses of the Small Bones of the Hand and Foot. Hereditary *os tibiale externum*. Jurgen Mestern. *Röntgenpraxis* September, 1934, 6, 594-600

Congenital synostoses of the small bones of the wrist have been described, they usually are of no functional importance. Only once has a familial occurrence of such anomalies been reported. The author had an opportunity to examine members of three families with congenital aplasias of the interphalangeal joints, and observed synostoses of small bones of the wrist and foot in the same patients. It seems it is not the single type of synostosis that is hereditary, but rather the disturbance which leads to synostosis of any of the bones. The anomaly was found in the hand as often as in the foot.

HANS W HEFKE, M D

RADIOLOGY

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NO. 4

ROENTGEN DIAGNOSIS OF CHRONIC ARTHRITIS¹

By HOWARD P. DOUB, M D, *Detroit, Michigan*

Department of Roentgenology, Henry Ford Hospital

IN spite of the tremendous amount of research which has been done on the subject, chronic arthritis still remains one of the great unsolved problems confronting the medical profession to-day. The lack of exact knowledge of the etiology of chronic arthritis has been a great handicap in its classification and management. The past few years, however, have witnessed a renewed interest in the subject and a closer co-operation of those interested. The formation of the new society, in this country, for the control of rheumatism is an indication of the efforts in this direction.

The classification has been gradually simplified and clarified until at the present time it is almost universally recognized that there are two great groups of arthritis. The terminology of these two groups varies widely in different parts of the world and to a lesser degree in individual countries. The terms "atrophic," "rheumatoid," and "proliferative" refer to the same type of arthritis, similarly, the terms "hypertrophic," "osteoarthritis," and "degenerative" refer to the same arthritic group. Because the terms "atrophic" and "hypertrophic" are more generally used in this country and, also, because the names are indicative of the principal changes seen on the roentgenogram, we prefer their use and shall use them in this communication.

The roentgen-ray diagnosis depends on both direct and indirect findings. Direct findings are those structural changes which can be definitely seen and measured on the roentgenogram, such as bone changes. The pathologic bone changes may be due to destruction, bone proliferation, or bone displacement. The physiologic bone changes are usually due to disuse of the part and are manifested by absorption of the lime salts, or osteoporosis. There may also be increased deposition of lime salts, or eburnation, in certain circumstances which will be spoken of later. Direct findings must also include swelling of the soft tissues about the joint, indirect findings are those changes which are not directly visible on the roentgenogram but which produce alterations in the visible structures so that certain pathologic processes may be inferred.

In this communication we shall discuss the changes in chronic arthritis of the peripheral joints only, and shall not discuss those of the spine, as we have recently covered them in another communication before this Society (2).

Atrophic Arthritis—Atrophic arthritis is a gradually developing polyarticular disease which may involve any joint in the body, the incidence being highest from the third to the sixth decades of life. It occurs frequently in individuals who are thin, viscerotropic, and of a neurotic type. The joints of the hands are often the seat of the

¹ Read before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis Tenn. Dec 3-7 1934

first symptoms There is a gradual development of pain, stiffness, and swelling of the joints which soon become fusiform in shape the development of pain produces

The swelling around the joint is due to fluid in the joint together with swelling of the synovial membrane and capsule Practically all writers agree that the disease be

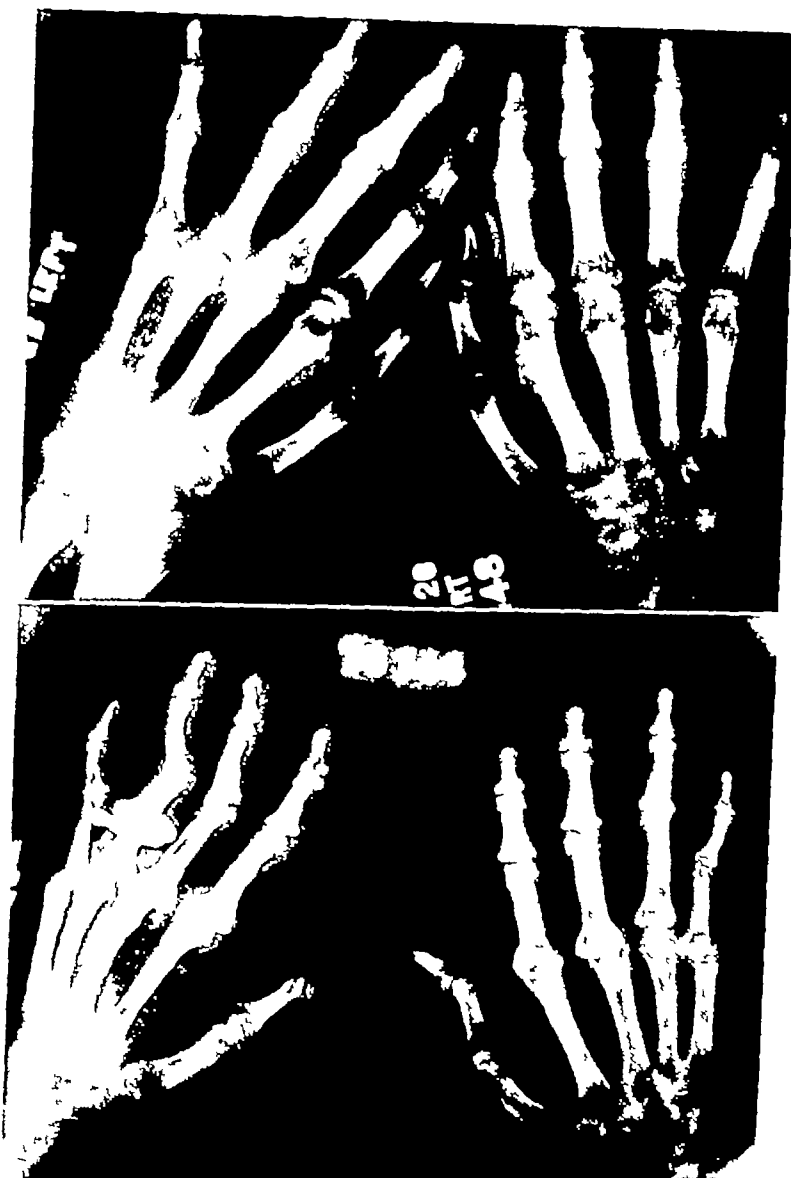


Fig 1 (above) Early stages of atrophic arthritis Osteoporosis with soft tissue swelling Very little cartilage destruction No bone destruction

Fig 2 (below) More advanced stage of atrophic arthritis with cartilage and bone destruction and beginning luxation of fingers

disuse of the joints which results in muscular and bone atrophy Unless the process is stopped at this point various degrees of deformity and ankylosis will result

gins in the synovial membrane and then spreads to the other joint structures The scope of this paper does not permit any detailed clinical or pathologic description, but

a few of the above facts are necessary to a proper understanding of the development of the roentgen-ray changes which we shall attempt to trace

cartilage As cartilage is not visible on the roentgenogram, indirect evidence of this destruction will be shown by a narrowing of the normal joint space This may be



Fig 3 End stage of atrophic arthritis with marked deformity and ankylosis

In describing the roentgen changes we shall attempt to show that they appear coincidentally with the progress of the disease, and in general are the result of certain well-known laws of cause and effect The earliest change is swelling of the synovial membrane and this, being an inflammatory change, is followed by a collection of fluid These changes are recognizable roentgenographically by an increase in the soft tissue shadow outline and also by changes in the normal position of the bones this is especially well shown in the patellar displacement There may also be obliteration of the normally clear area in the post-patellar space and in similar spaces around other joints These changes are not pathognomonic of atrophic arthritis, however, as the same changes may be seen in cases of acute polyarticular rheumatism, or after injury to the soft tissues of the joint No bone or cartilage changes are seen at this time

As the process continues to develop, the next structure affected will be the articular

slight or, in severe cases, there may be complete destruction of the cartilage so that the articulating portions of the bones may be approximated in the latter cases there are usually some areas of bone erosion At this time the disease has usually been present long enough so that secondary physiologic changes are present Owing to the disability, we find evidence of osteoporosis of the affected members and atrophy of the soft tissues above and below the joints Swelling of the joint area will usually be present, which produces the well-known fusiform shape seen in long standing inflammatory joint affections In some cases, there are punched-out areas of bone destruction along the articular surfaces such as are seen in gout, and in other cases there may be complete erosion of the articular surfaces Also, there may be partial or complete dislocation due to muscular contraction

When the progress of the disease is brought under control, the opportunity for



Fig 4 Early stage of hypertrophic arthritis with slight bone production. No narrowing of joint space.



Fig 5 Later stage of hypertrophic arthritis with more extensive bone production and beginning cartilage absorption.

reparative processes is at hand. The soft tissue swelling decreases, the articular cartilage which has practically no recuperative powers, owing to a lack of circulation, shows very little or no regeneration. In cases in which extensive destruction has taken place, ankylosis is usually the end result. In some cases there will be fibrous ankylosis, and in others in which the destruction has extended into the bone on both sides of the joint there will be an actual bony ankylosis.

The above description applies only to cases of sufficient severity to carry them through the entire course of the disease. All degrees of involvement are found, from those which show soft tissue changes only

and return to essentially normal joints, to those which end in complete disability of the patient.

Hypertrophic Arthritis—Hypertrophic arthritis is a condition common in elderly persons but which may be present in younger ones whose joints have been subjected to abnormal conditions, such as trauma. We believe that advancing age with its attendant factors of arteriosclerosis and fibrillation of the cartilage, together with long continued use of the joint, are the chief etiologic factors in this disease.

It has recently been shown by Keefer and Myers (7) that a high percentage of persons past middle age coming to autopsy show anatomic alterations similar to those

of hypertrophic arthritis. They believe these gross changes come about as a result of aging of the cartilage and from trauma. Trauma in this sense must include physiologic trauma from overuse of the joint and from faulty mechanics, as well as external trauma.

In the early stages, fibrillation and localized areas of destruction of the articular cartilage occur. This is shown roentgenographically by areas of roughening due to bone production at these sites. There is also the very commonly observed spur formation or lipping at the articular margins, especially at the attachments of the ligaments.

As the condition progresses, there is increasing cartilage disintegration which is shown by narrowing of the joint space and approximation of the bony surfaces. Inasmuch as these joints are not acutely painful, there is very little disability and, therefore, osteoporosis is not seen. There may even be some increased density of the bones, especially along the articular surfaces which may become highly polished and eburnated from the constant friction of the opposing bones. Small loose bodies called joint mice may be present in or about the joint, causing mechanical locking of the joint and sometimes swelling and increased fluid. These joint mice are composed of cartilage or bone or a combination of both and are usually derived from detached pieces of cartilage or bony exostoses. The marginal spur formations extend outward and toward the spur formation on the opposing bone and, while they may progress to a point where they are in close approximation, they rarely unite to produce ankylosis. In cases in which ankylosis occurs, it is usually due to mechanical interlocking or to some outside influence, such as severe trauma followed by bone production.

A rather mild and early form of hypertrophic arthritis is the occurrence of lipping around the bases of the terminal phalanges of the fingers. These are the so-called Heberden's nodes, and are very common in females past middle life who have worked



Fig 6 Anteroposterior view of knee shown in Figure 5

hard with their hands. There is widening of the articular surfaces with some increased density and considerable marginal lipping. There may or may not be narrowing of the joint space.

Cases of monarticular hypertrophic arthritis are sometimes seen and in many instances its presence may be ascribed to constantly repeated traumas. Probably the most typical example of this is seen in the hip joint. For many years this was described as a separate entity and was given the name "morbus coxae senilis"; it is now recognized to be the same as hypertrophic arthritis, affecting other joints. Some cases appear to follow slipping of the upper femoral epiphysis in childhood,

others may follow mechanical deformities which produce long continued strain. Roentgenographically, we see the characteristic spur formation which may be of extreme degree. There may be considerable deformity with absorptive changes in the head of the femur and sometimes a displacement of its normal position.

DISCUSSION

A summary of the main points set forth in regard to these two great types of arthritis reveals the fact that while in the main they are distinct entities yet they have certain points of similarity and frequently are seen as mixed types. They are also in some instances indistinguishable from other types of arthritis at certain stages of their course.

Atrophic arthritis is likely to be more rapid in its development, more disabling, and more painful than is hypertrophic arthritis. Osteoporosis is one of the prominent roentgen signs of atrophic arthritis, in hypertrophic arthritis, eburnation or increased density is usually present. The density of the bones is even greater than that usually seen in normal bones of this age period, as some grade of osteoporosis is usually seen after middle age. Both show evidence of cartilage destruction with narrowing of the joint space, but this process is more pronounced and occurs earlier in atrophic arthritis. Bone proliferation in atrophic arthritis is usually followed by ankylosis of the joint, while in the hypertrophic form marginalipping is one of the characteristic early roentgen signs and may not indicate the presence of any symptoms at that time. Ankylosis is a very infrequent occurrence in hypertrophic arthritis, although extensive bone production may be present about the joints.

Mixed types of arthritis are rather frequently seen and it is often difficult to say which type antedated the other. It is also difficult in some cases to distinguish between the two types from pathologic specimens, either by gross or microscopic examination.

Some of the pathologic and roentgeno-

logic changes which are seen at certain stages of chronic arthritis are quite similar to those seen in other types of arthritis. Tuberculosis and atrophic arthritis have some points of similarity which at times may cause confusion. Osteoporosis is a definite characteristic of each at certain stages, cartilage destruction is common to both, focal areas of bone erosion may occur in each, and pannus formation may be present over the cartilage. Osteoporosis in tuberculous arthritis is likely to be quite intense so that the articular surfaces are seen with difficulty and show a blurred appearance. This degree of osteoporosis is greater than is usually seen associated with atrophic arthritis and suggests that there is an osteolytic agent present. Cartilage destruction may be present in both types, but in tuberculosis it often appears after bone destruction has already been seen and may be a late development in the course of the disease. In atrophic arthritis it usually antedates bone destruction and is an early occurrence. In tuberculosis, various types of bone destruction may be seen but it commonly begins at the edge of the articular surface, along which it gradually extends with loosening of the overlying cartilage. Marginal erosion is also seen in atrophic arthritis and there also may be punched out areas of destruction along the articular surfaces.

Hemophilic arthritis may present roentgen signs that are similar to those of chronic arthritis. In mild cases there is effusion into the joint space, thickening of the joint capsule, and lipping similar to that seen in hypertrophic arthritis. In a more advanced group we find cartilaginous destruction. This may be local or may involve the entire cartilaginous surface of the joint. There is also bone destruction of two types: (1) punched-out areas in the epiphysis, with an intact articular surface due to hemorrhage into the epiphysis, (2) generalized destruction of the articular surfaces. In some cases the blood clot in the synovial cavity becomes organized and shows calcification, when this occurs, it is pathognomonic of hemophilic arthritis.

Gout is also a condition in which the roentgen findings may simulate those of chronic arthritis. The joints of the hands and feet show the most characteristic findings, but in many of the other joints the findings are not diagnostic. The typical roentgen changes are well defined rounded areas of destruction in the ends of the bones at the margins of the articular surfaces. There also may be destruction of the articular cartilage and erosion of the articular surfaces of the bones. There is usually not much osteoporosis present. In some of the milder cases there is lipping around the articular surfaces similar to that seen in hypertrophic arthritis. When the larger joints are involved, the changes often suggest hypertrophic arthritis but in these cases roentgenograms of the hands and feet may show the characteristic punched-out areas of bone destruction and afford a clue to the etiology of the disease.

SUMMARY

1 Chronic arthritis consists of the following two types (1) atrophic, and (2) hypertrophic.

2 A brief résumé is given of the basic roentgen changes which may be present in chronic arthritis.

3 Atrophic arthritis is described briefly from the clinical side, and more fully from the standpoint of the roentgen-ray changes.

4 The etiology of hypertrophic arthritis is referred to. Trauma seems to be a definite factor here. The roentgen changes throughout the course of the disease are described.

5 The differential diagnosis between chronic arthritis, tuberculous arthritis, hemophilic arthritis, and gout, is briefly discussed.

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SURGERY AS AN ADJUNCT TO THE TREATMENT OF ARTHRITIS¹

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THE application of surgical principles is often as essential in the treatment of arthritis as the determination and eradication of the causative agent. If the individual affected with arthritis is permitted to become helpless, or, if he is already in this state and is not restored to activity, his resistance and morale will become markedly depressed. The removal of all foci of infection, while absolutely essential, is often disappointing, as the joints may be an additional source of infection.

In 5,132 cases of arthritis taken from the records of our clinic, surgical treatment has been employed in approximately 900, which demonstrates how frequently such measures are required. With the exception of pyogenic infections, operative surgery is rarely indicated when the process is very active or acute. The response to surgery is more favorable in the residual stage after the process has subsided, however, it is frequently resorted to in sub-acute cases in order to restore more activity to the individual.

The main mechanical objectives are the prevention and correction of deformity, and the restoration of function. These may be divided into conservative or non-operative, and operative cases, as follows:

- | | | |
|---------------|---|---|
| Non operative | { | 1 Prevention of deformity |
| | { | 2 Correction of deformity |
| | { | 3 Restoration of function |
| Operative | { | 1 Drainage in acute infections |
| | { | 2 Excision of pathologic tissue |
| | { | 3 Brisement forcé |
| | { | 4 Plastic procedure for elongation of extra-articular contraction |
| | { | 5 Reduction of dislocations |
| | { | 6 Removal of mechanical intra-articular obstruction |
| | { | 7 Fusion |
| | { | 8 Reconstruction |
| | { | 9 Arthroplasty |
| | { | 10 Sympathectomy |
| | { | 11 Two or more objectives combined |

NON-OPERATIVE METHODS

1 *Prevention of Deformity*—When there is irritation in a joint from such cause as trauma, infection, or other agents, that joint will assume a position in which intra-articular pressure is the least and muscular relaxation is the greatest. This may be designated as the neutral position, an effort on the part of Nature to relieve pain and limit destruction from intra-articular pressure. Unfortunately such a position is one which, if permanent, will naturally impair future function, therefore, as long as there is any active irritation within a joint, it is obviously most important that an apparatus should be employed to maintain that position which will be most serviceable for future use. The neutral position is always one of more or less flexion. For example, an ankle joint is held in equinus or plantar flexion when there is intra-articular inflammation. This must be prevented by a splint which extends from the toes to just below the knee and holds the foot at a right-angle to the leg. The most serviceable position for future use is the position of choice in all joints. A knee which is flexed should be fixed in full extension, a wrist in extension, and an elbow at a little less than a right-angle.

2 *Correction of Deformity*—Unfortunately measures for the prevention of deformity are not always instituted or efficiently carried out, with the result that malformation often occurs. This may so impair function as to render the individual totally disabled. In those cases observed before there are slight organic changes of the joint or peri-articular structures, correction may usually be accomplished by continuous traction. If the organic changes are of a moderate degree, special apparatus constructed to meet the mechanical requirements of each joint may be necessary in order to restore the joint

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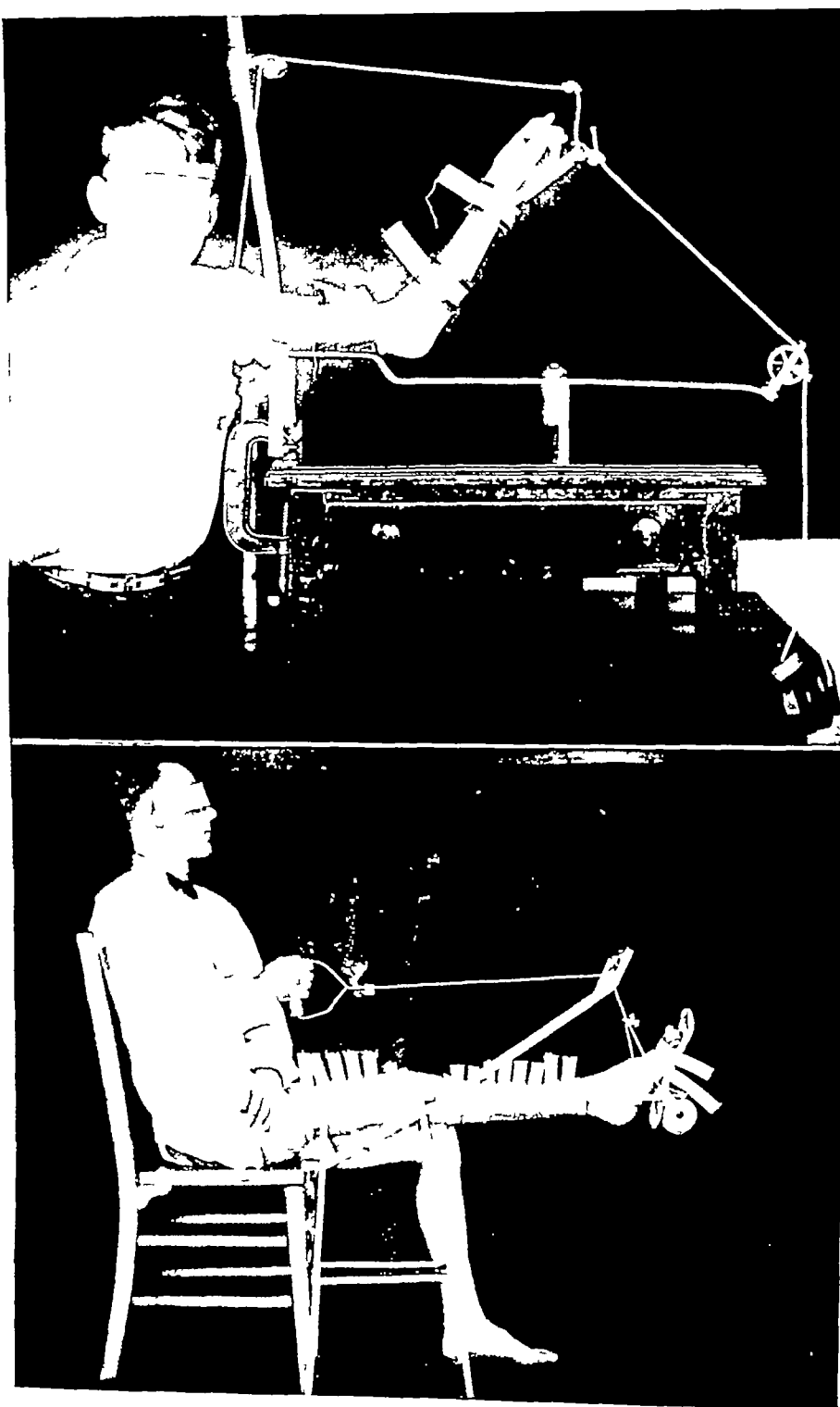


Fig 1 (above) Apparatus to facilitate the gradual induction of motion in the elbow
 Fig 2 (below) Knee exerciser to increase active and passive motion

to a normal position. Those suitable for such treatment are the joints that cannot be placed in the anatomical position on the thigh, preventing the usual tendency of the tibia to subluxate until complete extension is secured. When the joint has



Fig. 3 Overhead frame with system of pulley and rope to develop motion in the knee in bed ridden patients



Fig. 4 Specimen removed from knee at synovectomy showing hypertrophied synovial membrane and semilunar cartilage

account of adhesions or contractures, but possess a few degrees of motion. For example, in the knee, plaster of Paris casts or steel braces with turn buckles and pressure pads are applied so as to make traction and gradually extend the leg on

been restored to the most serviceable position for future use, splints or braces are applied to maintain the position and to permit function as early as possible. Splints must be more or less continuously applied until the individual can completely extend the joint or joints in question by his own volition. This statement cannot be emphasized too strongly, not only when conservative measures are employed, but also after operative procedure.

3 *Restoration of Function*—Active and passive movements are encouraged if local signs of inflammation are not instigated thereby. Rest is always indicated when any process is acute. Physiotherapy in various forms is often a valuable adjunct. Special apparatus is constructed to meet the requirements of each joint, designed to aid in active motion and increase passive motion. For example, in the elbow and the knee, apparatus is applied as demonstrated in Figures 1 and

2, which greatly facilitates the gradual induction of motion. Also, in Figure 3 is shown a system of overhead slings and compartment may rarely be necessary through the posterior capsule in the mid-line. After drainage of a knee, active motion

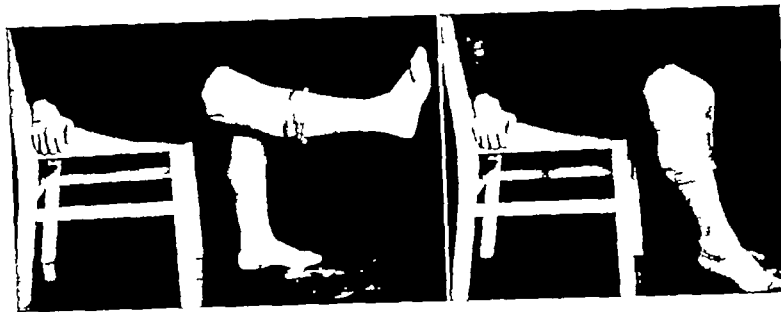


Fig 5

Fig 6

Figs 5 and 6 Post operative result following synovectomy of knee

pulleys with block and tackle which can be applied effectively at very little expense. These measures are beneficial not only when deformity has been prevented or corrected, as described above, but also after various operative procedures to be described below. If conservative or non-operative measures are applied in the early stage, operative treatment will rarely be indicated. Unfortunately, these procedures are seldom carried out and intra-articular and extra-articular changes that require radical surgery develop. Postural defects are of material importance and should be corrected in all cases, but so much has been written by Goldthwait, Swain, and others on this subject that detailed discussion is omitted.

OPERATIVE PROCEDURES

1 *Drainage in Acute Infections*—

Drainage in acute pyogenic infection of joints is rarely indicated unless the process is highly virulent, as indicated by symptoms of severe sepsis. When advisable, the incision should be made at that point which will give the most efficient drainage of the joint. In the knee, as a rule, two lateral incisions parallel with the patella are sufficient, but drainage of the posterior compartment, consisting of inner and outer incisions over the posterior aspect may be required. Drainage of the posterior com-

partment may rarely be necessary through the posterior capsule in the mid-line. After drainage of a knee, active motion



Fig 7

Fig 8

Figs 7 and 8 Post-operative result following bilateral posterior capsulotomy

efficacious in gunshot wounds, for which it was devised. The hip may be drained more effectively by the posterior method, as described by Ober. Early drainage is more often required in the hip, as a large portion of the neck of the femur is within the joint capsule, and direct infection of the bone or osteomyelitis is imminent.

2 *Excision of pathologic tissue* is obviously of value in loose bodies, enlarged villi, benign tumors, exostoses, and induration or fibrosis of the synovia. Loose



Fig 9

Fig 10

Fig 11

Figs 9 and 10 Flexion contracture of knee pre-operative and post-operative
 polyarticular arthritis

Fig 11 Progressive

bodies are more frequently formed as a result of osteochondritis dissecans, synovial osteochondromas or osteochondromatosis, and osteo-arthritis or the hypertrophic type of arthritis. Enlarged villi rarely mechanically interfere enough with function to require removal. Benign tumors such as lipoma, fibroma, and angioma should be removed, regardless of mechanical symptoms, as soon as the diagnosis has been made. Exostoses or osteophytes as a result of osteo-arthritis apparently may impair mechanical function and cause symptoms, but their removal rarely gives the desired relief. The operative procedure for these conditions is a very simple measure in the superficial joints such as the elbow, knee, and ankle, but is somewhat more complicated in the hip. In loose bodies, enlarged villi, and benign tumors the results are excellent as

a rule, as the etiologic factor is excised. In low grade infections, traumatic arthritis, osteo-arthritis and osteochondromatosis the synovial membrane may be indurated with enlarged villi, thickening of the capsule, and persistent fluid, distending the joint which may be resistant to every form of conservative treatment. In such a case much benefit may be secured by synovectomy, an operation which consists of excision of the synovial membrane. The operation is more frequently employed in the knee. A medial incision is made parallel with the quadriceps, patella, and patella tendon into the joint. The entire synovia is dissected from above downward with the semilunar cartilages and removed from the joint, the joint is then closed in routine manner and active and passive motion instituted on the tenth day. In monarticular affections, excel-

lent results are usually secured in a condition not amenable to any other form of treatment. Synovectomy also is employed frequently when the process is polyarticular. At times, foci of infection are removed in this manner and the general process arrested, however, the results are by no means as satisfactory as in monoarticular affections. Synovectomy absolutely refutes the old adage that the "loss of joint fluid or oil induces ankylosis." In fact, not only is the fluid lost, but the means by which the fluid is formed. However, after the operation a new synovial membrane is reproduced by nature, which secretes normal joint fluid.

3 *Brisement forcé*, or the employment of excessive force under anesthesia, very rarely is indicated in the treatment of injuries and diseases of the joints. Severe and irreparable damage, as crushing of articular surfaces, gross fractures, tearing of the articular structures, severe traumatic fractures, and relighting of virulent infection, often occur. Function in a joint usually can be cultivated to better advantage gradually and not forced. If adhesions are so strong as to require excessive force, open operative measures are indicated.

4 Plastic procedures for the elongation of extra-articular contractures are indicated when there is no involvement of the joint, and fibrosis of these structures has progressed to such a degree that restoration to the most serviceable position cannot be secured by the conservative measures described above. Operative measures for this purpose have improved materially during the past twenty years. Formerly, blind tenotomies, fasciotomies, and osteotomies were employed in which the function of important structures was impaired by severance and filling in with dense scar of the space gained thereby. This often later contracted, with more or less recurrence of the deformity. We now employ well planned open operations in which the contractures can be elongated with conservation of normal tissue and reduction of healing by scar tissue to a



Fig 12 Post-operative result following arthroplasty of both hips

minimum. These measures can be illustrated by certain operations. When there is extensive flexion contracture of the elbow, motion may be possible only from a right-angle to complete flexion. In order to secure extension, anterior capsulotomy is accomplished by a medial approach, the median nerve and vessels are isolated and retracted outward and forward, and the entire capsule is resected, which always consists of dense scar tissue. This often will permit complete extension. Otherwise, a lateral incision is made and the biceps and brachialis anticus are elongated by the Z-shaped plastic method. In flexion contracture of the knee by a similar procedure, the posterior capsule is severed, scar tissue resected, and if necessary, hamstring tendons elongated. If external rotation of the leg is present, the biceps is also elongated. This measure has almost completely replaced the supracondylar osteotomy, which caused deformity of more or less degree resembling a golf stick, and did not permit the return of the full range of motion. When the knee is fixed in complete extension by contraction of the anterior structures, elongation of the quadriceps muscles is secured which will

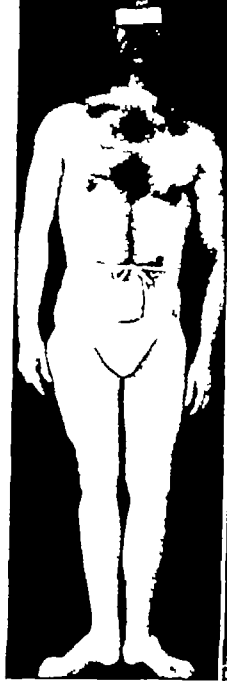


Fig 13

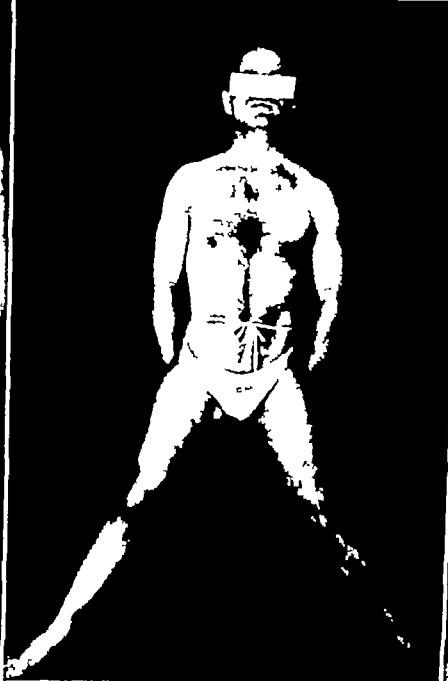


Fig 14



Fig 15

Figs 13, 14 and 15 Same patient as shown in Figure 12 showing motion present after arthroplasty of both hips and of left knee

permit full flexion. If the hip be extremely flexed in abduction or adduction, the operation described by the author as transference of the crest of the ilium may be employed. This consists of exposure of the hip by a long anterior incision. The gluteal muscles attached to the crest or dorsum of the ilium are severed at their attachment and the capsule of the hip is incised by a Z-plastic incision so as to conserve the Y-ligament; this will permit the limb to be extended. If the adductors are contracted, they may be severed at their insertion by a subcutaneous tenotomy; this will permit the hip to be placed in the desired position and the muscles to be reattached at a lower level. All structures are thus conserved, the normal nerve and blood supply having been in no manner impaired. The results are excellent and a functional range of motion is secured. In some instances there is a normal range of motion. When both hips or knees are involved, the individual is chair-ridden, but, after a series of operations as described

above, can often be enabled to walk. The very act of walking is an important agent in improving the morale as well as the resistance of the individual to combat the causative agent.

5 Reduction of dislocations unless obtained very early can be accomplished only by an open operation, as the adhesions are much stronger than the bone, which is always atrophic. Unless observed within one or two weeks after dislocation, reduction is practically always followed by ankylosis. The articular cartilage of the entire articulation undergoes rapid fibrillation and aseptic necrosis, for the joint fluid which acts both to nourish and to lubricate is lost.

6 Removal of mechanical intra-articular obstruction, usually caused by scar tissue, rarely by bone, is at times indicated, but more often is employed in conjunction with other measures described above and below.

7 Fusion or arthrodesis is an operative procedure for the purpose of inducing osseous ankylosis, and usually is indicated



Fig 16 Ankylosis of both hips due to progressive polyarticular arthritis



Fig 17 Same patient as shown in Figure 16 after arthroplasty of both hips

for the purpose of relieving pain in a joint in which the destructive changes are so advanced that restoration to a practical degree of painless function is impossible. The operation may be indicated in any joint but is employed more frequently in that of the hip. A wide exposure is made, with complete denudation of the head and acetabulum. In addition, the greater trochanter with muscle attachments is transferred across the joint and multiple flaps of cavernous bone are turned down from the ilium. The procedure is commonly used in monarticular affections, as in osteo-arthritis, or so-called *cova malum*, and in the residual stage after any destructive process has caused an irregular or incongruous articulation. In progressive polyarthritis, rheumatoid arthritis, or atrophic type of "arthritis deformans," one hip joint may cause such extensive disability from destructive changes, with excessive pain, that the individual may be unable to walk. In such cases the evolutionary process may require years before there is a relief of pain from osseous ankylosis. Therefore, the author has employed fusion in some instances, with arrest of the local process. This has enabled the patient to return to a more normal life and is a valuable adjunct to any form of treatment.

8 Reconstruction operation is employed only on monarticular affections of the hip joint. The operation was devised for ununited fracture of the neck of the femur. It consists in the excision of the head, detachment of the trochanter, and the placing of the upper extremity of the femur into the acetabulum, after which the trochanter is attached to the femur at a lower level. A movable joint is thus secured but it is not comparable to the normal joint, as there may be more or less pain and disability. Fusion gives more certain relief but many decline to submit to an ankylosed hip.

9 Arthroplasty is the reconstruction of a joint by a surgical operation when there is complete ankylosis. The operation consists of remodeling the articular surfaces, after which some material is interposed for the purpose of inducing free motion and preventing recurrence. For this purpose a free transplant of fascia lata is employed most frequently. This procedure may be employed when there is multiple ankylosis but is indicated more frequently in monarticular ankylosis, as a result of acute pyogenic infection after the process has entirely subsided and has reached the residual stage. Distinction must be made between an arthroplasty

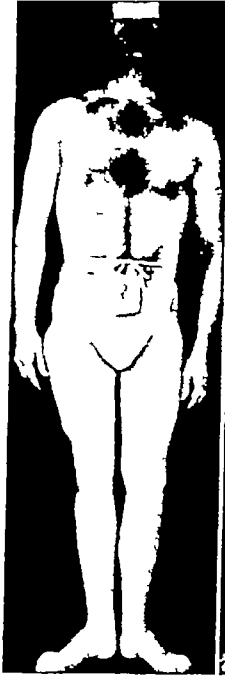


Fig 13

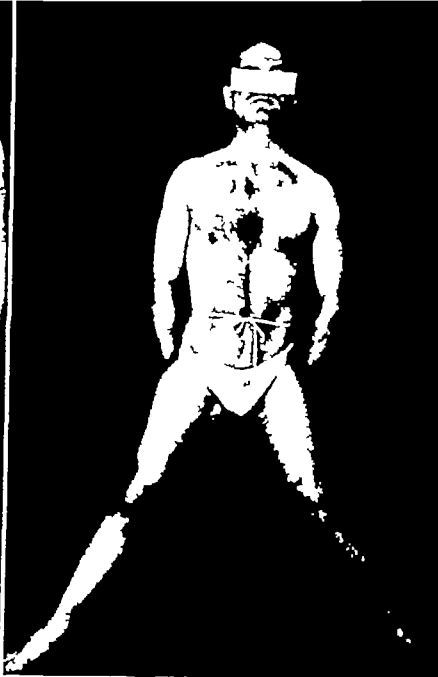


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Figs 13 14, and 15 Same patient as shown in Figure 12 showing motion present after arthroplasty of both hips and of left knee

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Fig 18 Ankylosis of hip following monarticular arthritis



Fig 19 Same patient as shown in Figure 18 after arthroplasty

The type of articulation reconstructed has been clearly demonstrated by the examination of specimens from joints in which motion has been secured by arthroplasty. For example, in a knee one year after operation there was a definite joint cavity about one-half the size of a normal joint, with joint fluid. The surface was covered with a fibrous membrane closely resembling the fascia lata which had been interposed at operation. The microscope demonstrated, counting from within out, a layer of fibrous tissue, fibrocartilage, and cavernous bone. The fibrocartilage was invading the sub-articular, intra-osseous spaces. In those joints that were examined after two or more years, the fibrous layer was substituted by fibrocartilage, but in no instance did it resemble normal hyaline cartilage. The same type of joint that is secured after arthroplasty has been demonstrated after complete destruction of an articulation from any one of

many causes, and must be regarded as Nature's substitute for a normal joint.

10 Cervical or lumbar sympathectomy, or the resection of the sympathetic ganglion, has been employed so as to produce vasomotion dilation, with elevation of the local temperature. This procedure is more in the province of neurologic surgery and has not as yet been employed sufficiently to determine its true value.

11 Two or more of the above procedures may obviously be combined, for example, arthroplasty and plastic procedures for the elongation of extra-articular contractures.

The selection of the procedure to be employed depends largely upon the structure and relation of the bones comprising the articulation, as demonstrated by the roentgenogram, and also the etiologic factor of the pathologic process. There may be extensive bone atrophy, more or less loss in continuity, sub-articular cysts

and excision or such measures as reconstruction. In arthroplasty there must be due regard to all of the component parts

tibia, and removal of as much of the posterior portion of the patella as was consistent with tensile strength. This

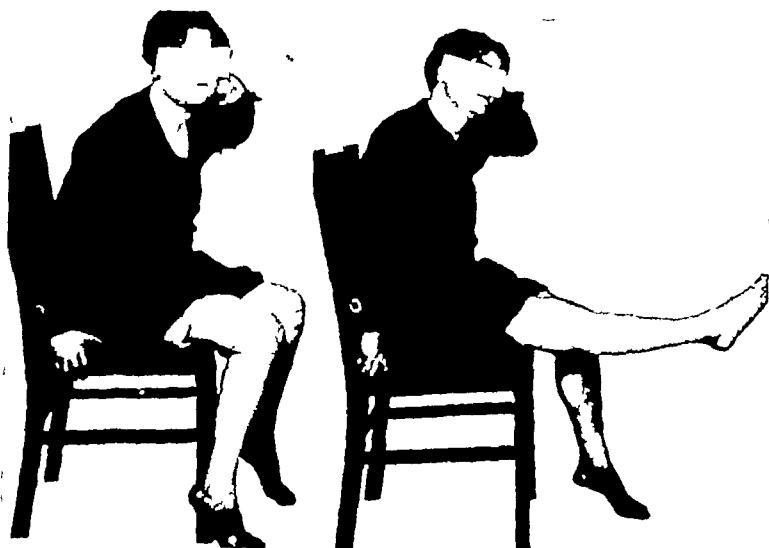


Fig 23

Fig 24

Figs 23 and 24 Motion present after arthroplasty of the knee

of the joint as muscles, ligaments, blood vessels, nerves, etc., if function is to be restored. Arthroplasty is not merely the removal of an area of bone for the purpose of inducing pseudo-arthritis. At best, a joint reconstructed by arthroplasty does not approach the normal, but an excellent, durable, and efficient joint may be restored. Anatomic restoration is not always possible or feasible. In the knee and elbow, the construction of a simple hinge joint will be an excellent substitute. The reproduction of the normal spine and the intercondylar notch with condyles and tuberosities will not function as a normal knee, for there are no crucial ligaments. The circulation is not sufficient to sustain the anatomic contour, which becomes modified in time by aseptic necrosis and absorption. Therefore, in 1918, I began to reproduce a different type of joint which consisted of making one convex condyle of the femur, one shallow concave surface on the upper extremity of the

restored a much simpler hinge joint, which gave practical function in a much higher percentage of cases than I had been able to attain by conforming strictly to anatomic contour. Arthroplasty is of particular value in the jaw, elbow, hip, and knee. These are the joints in which there is the greatest disability following ankylosis. In monarticular ankylosis a high percentage of restoration of function is secured. The results in multiple ankylosis and in those with progressive ankylosing arthritis are far from satisfactory, but, as the condition is so disabling and hopeless, any effort that offers the slightest chance of relief is worth a trial. In polyarticular ankylosis, there is much difficulty in securing the necessary after-treatment essential to the physiologic reconstruction of the new articulation because of the inability of the patient to co-operate in exercising the new joint. An analysis of the end-results has been previously published to which reference can be made.

we must depend almost entirely upon the manifestations as demonstrated by the roentgenogram

In ankylosis resulting from intra-articular infection, the manifestations in bone are confined to the articular surface and to the subadjacent bone for a short distance only. In fibrous ankylosis there is more or less condensation of the extremities of the bone which stand out in marked contrast to the structure of other bones of the extremity, or of the joint of the normal side, the joint line is visible though narrow. Osseous ankylosis presents the same appearance though exaggerated, and there is no visible joint line after the lapse of one year. By functional adaptation the marrow cavity after several years may encroach upon the joint so as to form a central canal connecting adjacent bone. When this occurs, the success of reconstruction operations is more doubtful, as there has been coincident functional atrophy of the muscles, and function cannot easily be restored. Also, foundation for a new articulation is not always available.

In ankylosis, as a result of extensive osteomyelitis, the causative agent is usually the same as in pyogenic infection, but the structure for a considerable distance is of dense eburnated bone which bears the same relation to normal bone as dense scar tissue does to normal soft tissues. The circulation is deficient and the quality of such bone is poor. Also, infection is dormant and may be relighted by any surgical procedure, therefore, reconstruction operations for the restoration of function are positively contra-indicated.

In attenuated pyogenic infections there are destructive changes, with condensation and erosion of the articular surfaces. The joint line is plainly visible, the sub-adjacent bone is normal, and some motion is present. In this type, operative reconstruction gives very favorable results.

In osteo-arthritis, or the hypertrophic type of arthritis, and in atrophic, rheumatoid, or progressive polyarticular ankylosing arthritis, the manifestations are

characteristic, well known, and require no discussion.

In syphilis there is increased density, hypertrophy of the periosteum and cortex, and definite punched-out areas of the articular surfaces, but differentiation can frequently be made by the Wassermann test.

The tuberculous joint is not under discussion, but as reconstructive surgery is usually contra-indicated when tuberculosis is the etiologic factor, differentiation is very necessary. In uncontaminated tuberculous joints, osseous ankylosis is very rare. There is usually a definite joint space with erosion, and at times destructive areas beneath the surface. Atrophy is more extensive in tuberculous joints, therefore, the bones comprising the articulation are relatively much smaller than those of the opposite side when compared with other affections. In tuberculous joints which have been contaminated with pyogenic organisms, differentiation may be impossible, as the characteristic reaction of such infections may completely obscure the tuberculous process. However, there are usually some of the characteristics of a tuberculous lesion and a pyogenic infection associated, as described above.

In most instances in the residual stage of arthritis the diagnosis by the roentgenogram alone is not required, as physical signs and past history are valuable evidence, and if combined with pathology, as demonstrated by the roentgenogram, an accurate diagnosis is usually possible.

In all types of arthritis there is a material danger of deformity which in many instances causes total disability and can be prevented by efficient apparatus that will permit ambulation. Also, deformity in the early stage can be corrected by the simple measures described above. The roentgenologist is often in the rôle of consultant, and, therefore, in a strategic position to advise orthopedic measures which will frequently prevent irreparable damage. Also, when much damage has occurred, he should be able to determine



Fig 20

Fig 21

Fig 22

Fig 20 Ankylosis of knee following monarticular infectious arthritis as shown in Figure 20 after arthroplasty of knee

Figs 21 and 22 Same patient

and cavities, sequestra, and extensive hypertrophy or condensation which may obscure cysts, cavities, or sequestra. When there is osteoporosis, bone structure should be restored as nearly to normal as possible before operative measures are employed. This can be accomplished by active use, unless gross deformity prevents, when correction of deformity is required as a preliminary step to permit active use of the part. In some instances the desired operation may be carried out, after which the return of normal bone structure is gradually induced by apparatus that permits only partial active use, as weight-bearing. If there is extensive loss in continuity, the reconstruction of any type of articulation that will permit function may be impossible, and such measures as osteotomy or fusion are usually indicated. When articular cysts or cavities are present, often a new base for an articulation cannot be reformed, thus restoration of function

may be impossible. In such cases, if no symptoms are present and the part is in the most serviceable position, no treatment is indicated, but if painful symptoms or malposition are present, operative measures are indicated. Sequestra and cavities visible on the roentgenogram through dense bone are frequently potential foci of dormant infection which may be relighted by operation. Also, pus cavities in the soft tissues and those entirely obscured by condensation and hypertrophy, not demonstrable by the roentgenogram, may be found at operation when not suspected.

Joints often react to different etiologic factors in a very similar manner. Therefore, differentiation by the roentgenogram is often difficult or impossible but is usually suggestive if not conclusive, as in bone tumors, the diagnosis may not be made by any one element, but may require an accurate history, roentgenogram, and biopsy. Often the history is obscure and

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the feasibility of relief by radical operative measures

During the past decade there has been an intensive study of arthritis, and more interest has been manifested by the general profession, which is undoubtedly giving much better results than in the past. This is due to more efficient treatment by

measures well known and not to any new specific remedy.

Arthritis is not in the province of any one specialty, but requires close co-operation of the internist, various other specialists, the orthopedic surgeon, and the radiologist, if success is to be attained.

THE RELATIVE VALUE OF RADIOTHERAPY, PHYSICAL THERAPY, AND HYPERPYREXIA IN THE TREATMENT OF ARTHRITIC DISTURBANCES¹

By J CASH KING, M D , *Memphis, Tennessee*

IT HAS been pointed out that arthritis is a constitutional disease in which the inflamed joints are only a symptom. Also that the use of physical energies constitutes only a part of the armamentarium employed in combating this disease. In arthritis, as in tuberculosis, we have no specific, but careful study and intelligent application of the many therapeutic measures has resulted in great progress in the management of the disease.

It would be impossible to describe here the indications, advantages, and disadvantages of the procedures making use of physical energies. Therefore, I wish to limit my remarks to generalities influencing the effectiveness of this type of treatment.

RADIOTHERAPY

The relative value of radiotherapy in arthritis is small. Its application reaps its greatest results in the painful, actively infected joints, and not in the very chronic, mildly active cases. The result is the relief of pain. This relief is quite similar to that obtained with radiation in the treatment of superficial infections, such as boils, carbuncles, etc. The analgesic action is probably through the influence on terminal nerves and upon the leukocytes that have already gathered at the site of active pathology, thus greatly augmenting the resolution of inflammatory reactions that have not become organized. The rays produced by high voltage currents that are well filtered have given the best results, in my experience, and they are considered safer. Since this is a chronic condition, a word of caution might be spoken against the prolonged use of radiation. It must

be remembered that there already exists an impaired vascularity in the affected parts.

PHYSICAL THERAPY

This is probably the oldest form of therapy known to man. After years of neglect and even abuse it is being revised, restudied, and utilized more prudently by orthodox medicine in the treatment of arthritis. Pemberton has remarked that "In no other disease has it a greater application than in arthritis, and heat, massage, and exercise constitute a triad without which few or no advanced arthritics can expect to recover."

The rationale of the influence of these measures is through their effect upon the following physiologic disturbances that accompany arthritis: impaired circulation, frequent sub-normal metabolic rate, impaired function of the intestinal tract, anatomic deformities and muscle atrophy that result in joint distortion, dry thickening of the skin over the affected joints. A knowledge of the influence that physical energies exert on these changes and the manner in which they influence them constitutes the most outstanding prerequisite of successful treatment. This might be compared to the axiom set forth by someone: "It is more important to know what sort of patient has a disease than what sort of disease a patient has." It appears that too much importance has been placed upon the technic and too little study on the physiologic changes produced by physical therapy.

The local application of heat to the affected joint causes dilatation of the vessels, improves the circulation of the blood and lymph, lessens pain, and permits a greater range of motion. Systemic exposure to heat increases the metabolic rate, induces profound sweating, and greatly accelerates the entire circulation,

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis, Tenn. Dec 3-7 1934.

An extemporaneous address presented in the absence of the speaker to whom this subject had been assigned.

particularly that in the subcutaneous tissues. It also induces alkalosis, which with extreme application leads to tetany.

The methods of producing localized heat are too numerous to even mention here, but they may be divided into three major groups: (1) dry heat or baking, (2) hydrotherapy or moist heat, (3) diathermy or other high frequency electrical energies.

HYPERPYREXIA

Any of the above-mentioned forms of heat will produce an elevation in the general body temperature to a greater or lesser degree, if the body is insulated against dissipation of this heat. Besides physical energies, numerous toxic substances familiar to all have been used to produce febrile reactions in arthritis. The physiologic changes associated with fever caused by toxic agents differ from those associated with fever by physical energies. The differences and merits of each have been discussed at length in the literature during the last few years. It is my belief that fever produced independent of toxic agents combats more effectively the pathologic changes of arthritis.

Within the last five years much enthusiasm, and in my opinion too much

enthusiasm, has been exercised in the use of physical energies in the treatment of arthritis. The error occurred because of the hope and through the efforts to find one form of treatment that might cure arthritis independently of other established beneficial measures now commonly used. I do not feel, however, that the entire responsibility for this error should rest on the shoulders of the physical therapist and others reporting results with these measures. The authorities on the subject of arthritis have been too slow in recognizing and utilizing these agents for their true value. In estimating the value of any treatment it must be remembered that arthritis is one of the diseases in which remissions may occur with little or no treatment, which undoubtedly is responsible for the great number of treatments offered and the claims made for each throughout the history of medicine.

In conclusion, I wish to say that the relative value of radiotherapy, physical therapy, and hyperpyrexia in the treatment of arthritis is in direct proportion to the understanding of the physiologic changes produced by these agents and the willingness of the physical therapist to co-operate with the internist, surgeon, and radiologist in an effort to give a patient the full advantage of each service.

MEDICAL ASPECTS OF CHRONIC ARTHRITIS¹

By RALPH A KINSELLA, M D , *St Louis*

MY PART in this symposium is to help to lay out for you the purely medical aspects of this problem of chronic rheumatism. In that way I shall avoid the surgical and orthopedic aspects, leaving the discussions of them to others.

There are several groups of chronic arthritis in the clinic, the most common being degenerative and rheumatoid arthritis. The roentgenologists have had a lot to do with the terminology of chronic rheumatism, the words "atrophic" and "hypertrophic" may have been derived from the x-ray appearances in these two main groups of arthritis. The hypertrophic, or the degenerative, variety has these two names because, in the roentgenogram of this type of arthritis, there seems to be a hypertrophic change. This change is revealed as protuberances and excrescences on the edges of bones making up joints, there is no loss of bone substance and, in general, the picture looks like one of production.

However, it has been found that in all individuals past the age of forty the wear on the joint surfaces brings about a gradual degeneration of the facing cartilages and at the same time, due to the forces of weight-bearing and traction by heavy muscles, a pulling out of the edges of the bones, so that these protuberances or excrescences are made up of true bone. The word "degenerative," therefore, is applied because the initial phase in the development of this type of arthritis is a degeneration, a splintering of the cartilage facing the joints. The words "hypertrophic" and "degenerative" are interchangeable.

With regard to the other type of arthritis, the so-called atrophic or rheumatoid, there have been many names. As stu-

dents, we learned about this condition as "arthritis deformans." The first penetrating investigation of the subject is recorded by Nichols and Richardson as far back as 1909. They were much impressed by the fact that the earliest lesion seemed to arise in the synovia, first as a round-celled reaction and later as a fibroblastic reaction, which spread from that point into the joint cavity, smearing over the surfaces of the bone like a pannus, at the same time gripping the ends of the bones in the same sort of process, and leading to the absorption and disappearance of calcium. This gives the ends of the bones a rarefied appearance and that is probably the source of the expression "atrophic." Nichols and Richardson preferred the word "proliferative" because the condition seemed to be entirely a chronic proliferative process.

The process is not unlike that of infection as it has been studied in experimental animals, when a more acute infecting agent, such as hemolytic streptococcus, has been used to produce arthritis. In this experiment the initial lesion likewise is in the synovia, outside the cavity, around the blood vessels, and spreads from that point into the joint cavity, running over the surface of the ends of the bones like a pannus, invading the underlying bone, spreading into the surrounding tendons and muscles, and finally being replaced by scar tissue which contracts and produces ankylosis by fibrosis. This is the only experimental arthritis which simulates the course of events in rheumatoid arthritis in humans and the idea that rheumatoid arthritis is possibly some kind of an infectious arthritis is sound. What kind of an infectious arthritis has not yet been determined.

The disappearance of the lime in the ends of the bone, and the rarefaction of the bone-ends generally, is apparently due not only to the disuse that these joints

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disabled joints from that in the corresponding joint on the opposite side which is not disabled. The fundamental process beginning in middle life continues to a greater or less extent in all joints and the joint that is disabled is usually so because of some peculiar and non-associated process. Infection is rare as a cause of disability in this type of patient, the most common causes of disability are mechanical forces, injury, and the mechanical disturbance incident to bad shoes or fallen arches.

The treatment we carry out in the arthritis clinic of the Firmin Desloge Hospital is almost entirely that of physical therapy. Of course, these patients also have what might be called an orthopedic survey. It happens that our arthritis clinic is conducted jointly by the Department of Medicine and the Department of Orthopedics, so that there is the greatest amount of co-operation and exchange of ideas in this field. These patients often need corrective orthopedic treatment which in itself, is sufficient to bring about proper carriage of weight and relief from disability.

The part that physical therapy plays seems to be important. At least, after these patients have gone to the Department of Physical Therapy for several months, they usually drop out of the clinic and we do not see them again for perhaps a year. Patients of this type tend to get better—they stop coming to the clinic, and feel that their treatments received in the Department of Physical Therapy were important in bringing about an improvement.

These treatments are of the kind which are most familiar and they range from diathermy, which the patients seem to like, to various types of massage and the application of heat by lamps. The drugs that we use for this type of patient are colchicum, because it sometimes happens that there is the factor of gout confused in this particular type of rheumatism, and the salicylates, for their analgesic effect. In general, we feel that a patient coming into the clinic with this type of rheumatism has a

favorable outlook, he can usually be returned to work.

The other type of chronic rheumatism, which is by far the most important because it is the most dramatic and the most tragic, is the so-called rheumatoid arthritis or atrophic arthritis. I have compared the sequence of events outlined by Nichols and Richardson in their study of early cases of rheumatoid arthritis with that sequence of events which occurs in experimentally produced arthritis in animals and have shown that there is a parallel between the acute infectious processes in an animal and the chronic process in the human. What the etiology of rheumatoid arthritis is, remains unknown. The most recent investigations have shown that the cellular reaction in the tissue just outside the joint cavity is suggestive of the cellular reaction found in acute rheumatic fever and, because the disease is frequently febrile in its early stages and locally shows redness and swelling around the joints, the expression "chronic rheumatic fever" is being used more frequently.

The mechanism of production of this type of rheumatism in humans is remarkably similar to that of acute rheumatic fever and gonorrheal rheumatism in that all of these types of rheumatism seem to depend for their beginning on the interposition of some shocking event. In the case of acute rheumatic fever, this event seems rather definitely to be some infection such as a sore throat, scarlet fever, and (it is said) even injury. Gonorrheal rheumatism is never seen immediately after an acute gonorrheal urethritis, it comes at some later day and usually follows something like an upper respiratory infection—a streptococcal sore throat, gastro-intestinal poisoning, and not infrequently an injury.

In the case of rheumatoid arthritis, it is very common to have a history of the first joint becoming involved following a drastic shock, a nervous shock of some sort—the loss of an important member of the family, a great fright, a devastating infection of some sort, and also injury

necessarily suffer but also to the actual absorption of calcium due to the pathologic process

Beside the degenerative and the rheumatoid, or atrophic, arthritis, a very common chronic type which comes into the clinic and the hospital is the chronic infectious arthritis that begins as an acute gonorrheal rheumatism. I wish to refer to this only briefly because its treatment is surgical and not medical. I am stepping outside the bounds by discussing treatment, which I believe is chiefly surgical, but this type of chronic arthritis is usually the result of an acute surgical condition.

I feel strongly that, in those cases in which it is known that the process is purulent, outside the joint, and in which the course will be chronic, prognosis is extremely unfavorable if that purulent focus is not immediately drained. There is ample experience to show that if the original focus is immediately drained, the infection is removed from the body and the future of the patient is secure. Of course, that does not mean that every case of gonorrheal rheumatism with a thin, straw-colored, copious effusion is a surgical case. We can distinguish between those cases that have copious, thin effusion in which it is extremely difficult to find any gonococcus, from those cases that are infiltrative around the joint, with dense, brawny, and exquisitely tender flesh, and in which gonococci are found with comparative ease both in smear and on culture. These more simple cases which seem to be almost non-bacterial can be expected to run a favorable course without any surgical procedure and get well in a few weeks without much of any special kind of treatment. But the other type, in which there is dense infiltration of the tissues surrounding the joints, in which very little fluid may be obtained out of the joint cavity itself, such fluid as is obtained being very purulent and easily yielding gonococci both in direct smear and on culture, is comparable to an abscess any place in the body, and harbors a focus which, if not removed, may be the feeding

point for arthritic change in many other points. Nothing is more unsatisfactory to treat than the case of a chronic gonorrheal rheumatism involving many joints.

With regard to the hypertrophic or degenerative variety of chronic arthritis, I have already described the pathologic changes that may be found. I have indicated that the process is thought to begin as a degenerative splintering of cartilage facing the joint cavity, as a result of the pressure of weight-bearing. This process occurs normally in all individuals past the age of forty, and even in those persons who have no arthritic symptoms. As such, it is purely a degenerative process and might be said to be a healthy person's disease. It is aggravated by any mechanical force which tends to increase the pressure on the weight-bearing cartilages, so that obesity, occupation, or orthopedic disturbances anywhere in the joints that affect the carriage of the body will aggravate and accentuate this development.

I have spoken also about the x-ray appearances of these joints. These robust types of individuals may go on for years without any particular disability, and when at last they come into the clinic the diagnosis is usually easy. It is usually a healthy-looking, robust, hypersthenic type of individual who comes in with one joint involved, usually the knee joint—some important weight-bearing joint—and the problem is often that of associated diseases as well as the particular problem of the joint itself.

It is difficult to say to what degree an infectious process is associated with the production of disability in this type of joint, but it is quite likely that in cases in which there is acute, red swelling about a joint in a patient of this type there is some infection in the body—in our experience most often in the urinary tract—which has something to do with a transplantation of infectious material or agent in the neighborhood of one joint.

As far as the x-ray is concerned, the evidence is not different in one of these

has been interested in recovering from the urine of these patients a proteose which he then gauges by skin tests with regard to the use of this material for vaccination and, beginning with subcutaneous doses and continuing with intravenous doses of proteose, 15 patients have been so treated in the past year, with the same sort of conclusions—that there are phases and periods of improvement and, in general, nothing to encourage the further use of this agent. Most recently we have been making vaccines from streptococci recovered from the throats of such patients, using these vaccines intravenously after determining their potency with regard to skin sensitivity, and we find that the patients seem to improve for a time, just as they did in the other forms of treatment.

Now the drugs that are used in the treatment of this type of rheumatism are chiefly salicylates, which are used for their analgesic effect, and sulphur. It is easy to condemn their use, to say that they do no good, but they do relieve pain, and those practitioners who use large doses of salicylates by rectum are much impressed by the amount of good they are doing simply because they do relieve pain. No sulphur has been used in the arthritic clinic of Desloge Hospital but a great deal of it has been used in the orthopedic clinic, and, as I said, the departments of medicine and orthopedics are joined in the study of arthritis.

We cannot feel that, in this type of rheumatoid arthritis, the use of sulphur has done anything in a very important way. I suppose that 50 or 60 patients have been treated with as many as from 75 to 100 injections of sulphur. The very fact that so many injections are used is an indirect argument against the value of the drug.

The Department of Orthopedic Surgery renders valuable service in the relief of these patients. There is a form of treatment in vogue in many parts of the country which consists of putting the contracted joints in casts at night during sleep, the idea being that these patients

tend to flex their joints to the greatest extent during sleep and, when they awaken in the morning, suffer a great deal of pain and disability in the attempt to straighten out these joints, with the result that they do not straighten them out and ankylosis progresses, and the fixation of the joint in an ectopic position is emphasized. This form of treatment is a very important one in our experience at Desloge Hospital.

I wish merely to refer to an experience that we have had with regard to the surgery of the sympathetic nerves and the injection of femoral arteries with alcohol in the treatment of this particular kind of rheumatism. There have been about thirty-five cases of rheumatoid arthritis treated by sympathectomy—lumbar sympathectomy—which has been done usually on one side for the purpose of studying its effect on the pain and the movement of joints on that side in the lower extremity. Curiously, our first results were so good that before the investigation was over about thirty-five patients had submitted to this operation. However, we do not advise it because subsequent results did not justify its continuation. The relief of pain was not constant. The improvement in the movement of joints, which was due to the relief of pain, was therefore not constant, and the procedure was finally discontinued.

We then thought that we might imitate the same effect by exposing the femoral artery and then packing the tissue around it with alcohol. Here again the first one or two cases in whom we resorted to this procedure were relieved of pain in the joints on the same side and, therefore, used these joints with greater freedom, but later cases did not show this sort of improvement.

In speaking of the prognosis of this type of rheumatism there are two things that are extremely important, one being that these patients tend to have remissions. Bearing that in mind, any sort of treatment that is offered must be criticized because the improvement that is ascribed to the treatment may be an improvement that the

So, the production of these forms of arthritis is somewhat similar and it reinforces the idea that rheumatoid arthritis is probably an infective process

As was said at the very beginning of this paper, it is extremely unfortunate that to-day we have no special message with regard to the treatment of rheumatoid arthritis. However, it ought to be emphasized that treatment, whatever it is, is very important as contrasted with none at all. Whatever the local joint-display may be in these patients, the thing that is of most importance is that as human beings they are tremendously discouraged, suffering from pain and weakness. For that reason, therefore, it is important that some routine of treatment should be employed, it is surprising how much improvement may be obtained in any given case even if ultimate cure cannot be expected.

I wish to refer to one routine of treatment that we use in the Firmin Desloge Hospital.

Our idea is to keep the patients occupied, having them visit the Department of Physical Therapy twice a day. In the morning they receive some sort of bath, which may be a cabinet bath, the packing of the body in blankets, or the immersion of the body in hot water. Any maneuver which succeeds in bringing about a general reaction of the skin is the one that is used, and it is not always the same one in all patients because they seem to have their preferences. We have, in a few cases, resorted to artificial fever, but one apparently unfavorable effect has led us to be extremely careful in the use of this procedure.

Then, during the day, these patients are given something to do with their hands, some form of occupational therapy, of which there are many about a hospital. In the afternoon they again go to the Department of Physical Therapy and receive bakes and massage. The effect on the morale of the patients is remarkable, they come into the hospital usually late in the disease, after several years of dis-

ability, considerably discouraged, and every effort made in their behalf seems to them to be cheering and beneficial. They are encouraged to walk and helpers are available who walk them up and down the corridors regularly and improve the range of the use of joints.

The most important treatments reported in the literature to-day are those with various types of vaccines. There is more work going on in this field than in any other therapeutic field with regard to this type of arthritis. There are several kinds of vaccines, the most commonly spoken of being the ones made from the hemolytic streptococcus. I am not sure that any special kind of streptococcus has been used, the reports indicate that certain forms have been used—usually those obtained from the patient or those obtained from some other worker who has kindly supplied what he calls a "typical" strain.

But the whole question of the etiology or rheumatoid arthritis with reference to hemolytic streptococcus is still unsettled. There are very many reports which indicate that streptococci of some variety may be obtained from the blood and joint fluids of patients with rheumatoid arthritis, but there are just as good reports to show that these results are not accurate. However, the problem must remain in a state of doubt at present, for the reason that there probably is no special strain of streptococcus to be used as a vaccine in the treatment of this type of rheumatism.

We have treated during the past year at the Firmin Desloge Hospital, eight patients by intravenous inoculation of hemolytic streptococci. We have not gauged the doses by the skin test, a method which is advised in the latest writings. However, our doses have been such as could have produced favorable results if the treatment was the proper kind. We have not been impressed by the results. The temporary periods of improvement are not unlike those that seem to attend any form of treatment.

One of our associates, Dr. Muether,

has been interested in recovering from the urine of these patients a proteose which he then gauges by skin tests with regard to the use of this material for vaccination and, beginning with subcutaneous doses and continuing with intravenous doses of proteose, 15 patients have been so treated in the past year, with the same sort of conclusions—that there are phases and periods of improvement and, in general, nothing to encourage the further use of this agent. Most recently we have been making vaccines from streptococci recovered from the throats of such patients, using these vaccines intravenously after determining their potency with regard to skin sensitivity, and we find that the patients seem to improve for a time, just as they did in the other forms of treatment.

Now the drugs that are used in the treatment of this type of rheumatism are chiefly salicylates, which are used for their analgesic effect, and sulphur. It is easy to condemn their use, to say that they do no good, but they do relieve pain, and those practitioners who use large doses of salicylates by rectum are much impressed by the amount of good they are doing simply because they do relieve pain. No sulphur has been used in the arthritic clinic of Desloge Hospital but a great deal of it has been used in the orthopedic clinic, and, as I said, the departments of medicine and orthopedics are joined in the study of arthritis.

We cannot feel that, in this type of rheumatoid arthritis, the use of sulphur has done anything in a very important way. I suppose that 50 or 60 patients have been treated with as many as from 75 to 100 injections of sulphur. The very fact that so many injections are used is an indirect argument against the value of the drug.

The Department of Orthopedic Surgery renders valuable service in the relief of these patients. There is a form of treatment in vogue in many parts of the country which consists of putting the contracted joints in casts at night during sleep, the idea being that these patients

tend to flex their joints to the greatest extent during sleep and, when they awaken in the morning, suffer a great deal of pain and disability in the attempt to straighten out these joints, with the result that they do not straighten them out and ankylosis progresses, and the fixation of the joint in an ectopic position is emphasized. This form of treatment is a very important one in our experience at Desloge Hospital.

I wish merely to refer to an experience that we have had with regard to the surgery of the sympathetic nerves and the injection of femoral arteries with alcohol in the treatment of this particular kind of rheumatism. There have been about thirty-five cases of rheumatoid arthritis treated by sympathectomy—lumbar sympathectomy—which has been done usually on one side for the purpose of studying its effect on the pain and the movement of joints on that side in the lower extremity. Curiously, our first results were so good that before the investigation was over about thirty-five patients had submitted to this operation. However, we do not advise it because subsequent results did not justify its continuation. The relief of pain was not constant. The improvement in the movement of joints, which was due to the relief of pain, was therefore not constant, and the procedure was finally discontinued.

We then thought that we might imitate the same effect by exposing the femoral artery and then packing the tissue around it with alcohol. Here again the first one or two cases in whom we resorted to this procedure were relieved of pain in the joints on the same side and, therefore, used these joints with greater freedom, but later cases did not show this sort of improvement.

In speaking of the prognosis of this type of rheumatism there are two things that are extremely important, one being that these patients tend to have remissions. Bearing that in mind, any sort of treatment that is offered must be criticized because the improvement that is ascribed to the treatment may be an improvement that the

patient might enjoy without such treatment. The other point is that the disease subsides, it finally stops being painful and every effort should be made before that time to keep the body moving and to conserve as far as possible the function of the joints, so that if—and when—the disease stops the patient may find himself not a complete cripple.

The treatment of arthritis is palliative, like the treatment of cancer, with its palliative surgery or palliative roentgen radiation, which brings comfort to the patient in some way and for that reason is essential.

DISCUSSION OF SYMPOSIUM ON CHRONIC ARTHRITIS

DR ROBERT S. STONE (San Francisco) The duties of a roentgenologist may be divided into three. In the first place, he has to diagnose specific lesions in specific parts of the body, in the second, he has to treat specific lesions in specific parts of the body, and in the third place, he has to act as a consultant on the general condition of the patient who happens to have the lesion he is either diagnosing or treating.

I feel that this symposium has been well arranged in that it gives us a chance to see all the different sides of this question in regard to arthritis. One sometimes wonders of what value it is, in a radiological symposium, to have a paper on the medical management of arthritis and one on the surgical management of arthritis, but I feel that these are subjects that we should know more about than we do.

When a patient is brought in to an x-ray department or an x-ray office by such a man as Dr. Campbell, there is no question about the judgment of the man who has charge of the patient or about what he should do for the patient. If the patient is brought in by a medical man of the standing of Dr. Kinsella, there is no question but that he is going to have the proper management. However, we all have doctors who refer patients to us—doctors who do not know so well these diseases or their management. Seeing the patient very early in the course

of the disease, we should be able to offer advice or suggestions to his doctor which may help the latter and lead to the prevention or the correction of deformities, or induce him to refer the patient to one who can give the proper medical management.

I think that our duties as roentgenologists extend far beyond just describing the morphological condition that is present. We are consultants, and must be prepared to discuss therapy as well as diagnosis. I am very glad, therefore, that we have heard these papers, which give us a better insight into what can be done and help us to advise those who are not specialists in these conditions.

DR JACQUES FORESTIER (Aix-les-Bains, France) I ask permission to bring to you two points to make this discussion very short and, if possible, effective. The subject has been so well covered that there is no necessity to discuss further any of the points brought out here, but I would like to call your attention to two points, one diagnostic and one therapeutic.

The diagnostic point deals with the question of calcification in the spine, which seems to have some importance, and I want to illustrate¹ that there are two types of anatomical changes which may be detected by x-ray in the spine and which are very often confused, at least in my country, and lead to quite different clinical pictures.

The first type of change is what is generally called "osteophyte" or "bony spur." The second type of change is what my chief, Sicard, and I have called "syndesmophyte."

[The first slide shown] is a typical picture of the osteophytes in the cervical region. You can see theipping of the two vertebral bodies and you can see that there is a space between them, too, in spite of the fact that they seem to go one against the other.

[The second slide shown] is another os-

¹ Slides were shown but not left with the Editor for reproduction and that part of the discussion based upon them will therefore lack clearness to those readers who were not present at the meeting.

teophyte in the dorsal region. It is very important to notice that in these two cases it is the same bone formation, it is a spur which belongs to the vertebral body, which is a growth arising from the bony tissue itself, from the cancellous tissue, and which is also covered by a cortex. This is a bony formation from the bone itself. It is the osteophyte. It is a type of change which has been described here and which does not lead to ankylosis. It is of degenerative nature and should be classified in the group of hypertrophic arthritis.

On the other hand, here [third slide] is quite a different form of ossification, of calcification, at the anterior edge of the vertebræ. You see that it is a small linear shadow which is much less dense than that of the vertebral body which is not in continuation with the bone itself but is an addition, a calcification which has developed inside the vertebral ligament and will soon unite the two adjoining vertebræ. We call it "syndesmophyte." It is most important to note the difference between these two forms of changes because this last form leads more or less, sooner or later, to ankylosis of the spine.

On the patient [shown in the fourth slide] you see on the right side the spinal column in its cervical segment, on the left side the lumbar region. In each of them you see syndesmophytes, that is to say, the type of bone formation which belongs to the ligament and not to the vertebral body. This is the ankylosing type, which is very well illustrated by the fact that in the lumbar region you can see similar calcifications of the ligaments which are not osteophytes but syndesmophytes, and which have brought about a full ankylosis.

The last point which I want to emphasize about treatment is that in an experience of over ten years in the treatment of arthritis I have almost entirely discarded the use of vaccines. It seems to me that in a chronic disease, even if it is infectious, the fact that the disease is chronic proves that the body is unable to make any spontaneous reaction against the infection, so that it is quite useless to try to increase

a sort of reaction of defense which does not exist at all.

Vaccine therapy is a logical procedure every time the disease has a tendency to wear out by itself, and it may bring about a better and quicker cure by stimulating some reaction which is existent but too small, but it is unable to bring about a curative reaction when there is no reaction at all from the body. This is the reason why, for six years, I have been using a chemical therapy which has proved, in France and in some other countries of Europe, to be more effective than many other chemical therapies. That is the use of gold salts.

I have given a few discussions of this subject in this country and I want to emphasize the fact that the gold salts therapy gives remarkable results when it is carried out in conjunction with the auxiliary treatments—physical therapy. In France and elsewhere in Europe we use very much the spa treatment with the natural mineral hot waters. When this gold salts treatment is carried out for a sufficient length of time, it is able to bring about cures which are not obtainable by other forms of treatment.

DR CAMPBELL (closing). In 1916 in an article entitled "Osteospondylitis," before the Orthopedic Section of the American Medical Association, I described the manifestations defined by Dr. Forestier as "localized syndesmophyte." They are areas of calcification beginning in the center of the intervertebral ligaments, and may later fuse with the margins of the vertebræ above and below. The condition I described was very acute and some of the cases were sequelæ of acute infectious diseases, as pneumonia.

A typhoid spine may react in the same manner. This osseous reaction I have always regarded as the result of inflammatory changes in the intervertebral discs.

Syndesmophytes differ from osteophytes in that they may form a complete osseous bridge with osseous ankylosis, while osteophytes are merely marginal proliferation and do not cause a continuous growth uniting two vertebræ.

CONGENITAL LUNG CYSTS IN INFANTS AND CHILDREN

By SAMUEL GEORGE SCHENCK, M D , and JACOB L. STEIN, M D ,
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From the Radiological and Pediatric Departments of the Jewish Hospital

PULMONARY cysts of congenital origin are considered a very rare condition. Up to 1925, Koontz (1) was able to collect 108 cases based on autopsy findings, all of which were published in the European literature. His case report, however, was not the first to appear in the American periodicals. In 1913, Pappenheimer (2) described the necropsy of a seven-months premature infant with multiple congenital cystic cavities in the right lung. The child was cyanotic and made some feeble efforts to breathe, he lived for only three hours under artificial respiration. In 1919, Koeckert (3) described an enormous cyst filling the greater part of the chest in a new-born infant who lived for only two hours, with symptoms of cyanosis and marked dyspnea. The microscopic study of the walls of the cyst revealed its bronchial origin. Since 1925, 120 new cases have been collected from the world's literature, 49 of which have been verified by necropsy. This apparent increase of reported cases is due to the fact that clinicians, stimulated by Koontz's paper, are more on the alert to recognize the condition. In addition, roentgenologic technic has been improved considerably, with the result that many new cases have been discovered during life which might otherwise have passed unrecognized. The following interesting case prompted this report.

R S, a male infant, weighed seven pounds four ounces at birth. Labor was normal and the delivery spontaneous. The infant cried lustily at birth. There was no history of illness during the first weeks of life, however, on Aug 9, 1933, at the age of five weeks, the patient was seen because of insufficient gain in weight, which was then eight pounds four ounces. The child appeared well developed, and on physical examination there was no evidence of any

pathology in the chest or elsewhere. The thorax was symmetrical, and both lung-fields were apparently negative to percussion and auscultation. However, routine roentgenoscopic examination of the chest revealed a large, circular, dense shadow occupying the middle of the right lung bed.

The roentgenograms (Fig 1), taken on the following day, showed a well circumscribed area of opacity situated in the right pulmonary field and occupying about one-half of the lung space. The pulmonary apex and base were clear, and the left lung bed was normal. No displacement of the heart and mediastinal structures was noted. The lateral view (Fig 2) showed the ovoid area of opacity to be intrapulmonary, and not part of or connected with the mediastinum or pleural cavity. The roentgen impression was congenital fluid lung cyst, not connected with a bronchus.

The infant was again seen on Aug 19, 1933, at which time his weight was nine pounds eleven ounces, showing a gain of one pound five ounces in 10 days. Since the first visit, he had coughed up brownish fluid, otherwise, the patient had no other symptoms. There was no elevation in temperature, breathing was not rapid, and cyanosis was absent. The intradermal tuberculin test (Mantoux) up to 5 mg was negative. Follow-up roentgen examination (Fig 3) at this time portrayed a definite, clear zone, indicative of air, occupying the upper half of the ovoid opacity in the right lung, and the presence of a fluid level in its lower half. It was felt that a solitary cyst had ruptured into a bronchus at the time when the child had the above-described coughing spell and the brown viscid fluid was raised.

On Sept 3, 1933, the patient was again observed, at which time he showed a gain of two pounds three ounces in 15 days, and



Fig 1 Roentgenogram taken on Aug 10 1933 Dense ovoid area of opacity is observed which lies in the middle of the right lung field and occupies more than half of the pulmonary field The right apex and base are clear The heart is not displaced The findings suggest a solitary fluid cyst



Fig 2 Roentgenogram taken on Aug 10 1933 Lateral view of the chest shown in Figure 1 The dense oval opacity is clearly seen lying within the lung-field Its anterior border merges with the cardiac shadow and its posterior surface extends to but does not lie in the posterior mediastinum, which appears clear

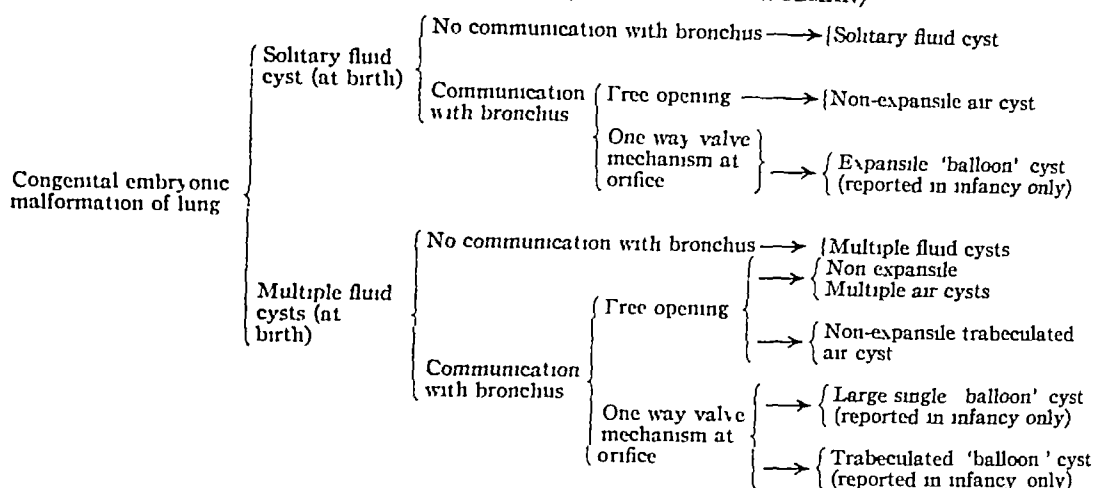
was symptom-free Roentgenographic study (Fig 4) portrayed a curvilinear shadow in the right lung, about the same size as noted on the last films, with an entirely clear central zone No retained fluid was observed, air occupied the entire cavity, the walls of which were moderately thin When observed again, two months later, all the encapsulated air had disappeared, the walls were absorbed, and the lung markings appeared normal The child continued to gain in weight, and appeared well nourished and healthy in every respect Repeated examinations (Fig 5) failed to disclose any abnormal or pathologic findings Observed for over a year and a half, the child remains well and symptom-free

Comment—This case represents a solitary non-expansile fluid cyst in an infant five weeks old, with no symptoms referable to the chest During a bout of vigorous coughing, the infant raised some thick tena-

cious fluid When roentgenographed later, the cyst revealed air and a horizontal fluid level, which suggested a rupture of the cyst into a neighboring bronchus or bronchiole Finally, the cyst, entirely replaced by air, collapsed and the lesion spontaneously disappeared

Classification—From the clinical standpoint, the classification of congenital lung cysts suggested by Anspach and Wolman (4) is very satisfactory Most classifications are based on the pathogenic characteristics or on the etiologic factor Daniels and Jezsovics (5) considered congenital cysts or congenital bronchiectasis to be localized or diffuse, and as agenetic (Kaufmann, 6), atelectatic (Heller, 7), or idiopathic (Bard, 8), depending on what the writer believed to be the etiologic basis of the lesion Far more practical from a clinical viewpoint is the classification recommended by Anspach and Wolman (Table

TABLE I—SUGGESTED CLASSIFICATION OF CONGENITAL LUNG CYSTS ON THE BASIS OF POST-NATAL BEHAVIOR (ANSPACH AND WOLMAN)



I), they considered that all congenital cysts, whether solitary or multiple, contain fluid at birth. Wolman's (9) six-months stillborn fetus had fluid in the bronchogenic cyst. Pappenheimer (2), Kessler (10), Grawitz (11), Koeckert (3), Huckel (12), Melchior (13), Tyson (14), Smith (15), Collins (16), Swanson, Platou, and Sadler (17), and others have also described infants with fluid cysts.

At birth, a solitary fluid cyst may or may not communicate with a bronchus. If it does not, it remains as a solitary fluid cyst, comparable with a cyst elsewhere in the body. However, if it communicates with a bronchus, it will present one of two pictures: air and fluid with a fluid level, or a cavity with air alone. If a free communication between the cyst and the bronchus exists, and air is allowed to enter as well as to leave the cavity through the communicating orifice, the cyst will not increase in size or "balloon." This is the so-called non-expansile air cyst. If, on the other hand, air enters the cavity and becomes locked in so that it cannot easily escape, the cyst enlarges or "balloons," becoming an expansile or a "balloon" cyst. The inability of the air to escape is due to compression of the communicating bronchus by the cyst, resulting in a one-way valve effect at the orifice. This mechanism has been

clearly shown by the autopsy records reported by Jacobs (18), Nelson (19), and others.

As in solitary fluid cysts, so in multiple fluid cysts at birth, there are those which communicate with a bronchus and those which do not, the effect being the same as in a solitary cyst. If the multiple cysts have a bronchial outlet, the nature of their communicating opening will determine whether or not they become expansile. With a free orifice they do not expand, but if the bronchial opening admits air and yet is closed during the expiratory phase due to pressure from without, the findings may reveal a large single solitary balloon cyst or a trabeculated one.

Although there are no available statistics on the incidence of lung cysts, it appears from all reports that the condition is rare. Lenk (20) observed six cases in 10,000 roentgenologic examinations of the chest. One of the writers (S. G. S.) has recognized only one in about 25,000 roentgen studies of the chest. Polayes (21) failed to find a case in over 3,000 autopsies which included many infants. In patients 15 years of age or younger, 106 cases have been collected altogether. Pulmonary cystic disease was recognized in 26 patients at birth, 41 were under one year of age, and in the remaining 39 the lesion was discov-

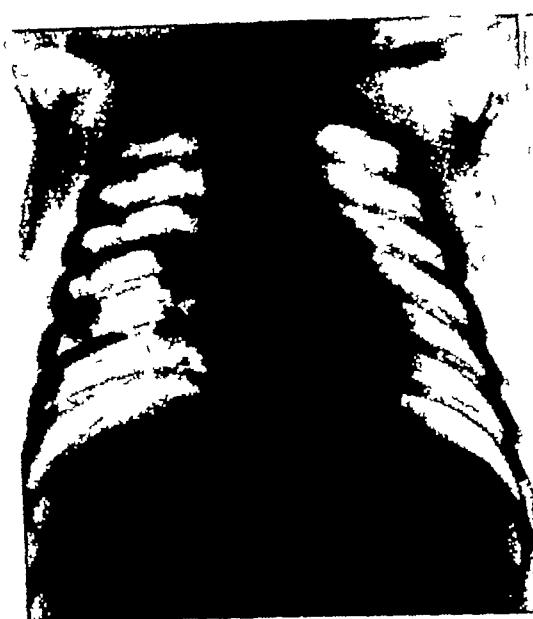


Fig 3 Roentgenogram taken on Aug 19 1933 The dense shadow in the right lung now shows a clear zone in its upper half, suggesting the presence of air, which has replaced some of the fluid in the cystic cavity The presence of air indicates a rupture of the cyst into a neighboring bronchiole.



Fig 4 Roentgenogram taken on Sept 3, 1933 In place of a dense shadow or an opacity with a clear translucent zone, there is now present a large spherical area of clarity in the midportion of the right pulmonary field Air has replaced all of the fluid in the cyst The wall of the cavity is clearly shown and appears to be moderately thin

ered between the ages of one and 15 years. Sex apparently plays no rôle in the incidence. Of the patients in whom the sex was mentioned, 36 were males and 42 females. The right and left lungs are about equally affected, contrary to the previously expressed opinion that the lesion predominates in the left lung. The right lung was involved in 35 patients, the left in 39, and the lesion was bilateral in 23 children. Single or multiple congenital lung cysts vary in size considerably. A solitary cyst may be so large as to occupy the entire pulmonary field, extending from apex to base and even beyond the midline, compressing the lung to a mere shell in all directions, displacing the heart and mediastinal structures well to the opposite side, and flattening the diaphragmatic dome on the affected side. The compiled cases are divided into the following types: solitary non-expansile fluid cysts, 21; solitary non-expansile air cysts, 12; solitary expansile or balloon cysts, 21; multiple non-expansile fluid cysts, 23; multiple non-expansile air cysts, 26; multiple expansile cysts, 2.

Etiology and Pathology—The etiology and pathogenesis of congenital lung cysts are still obscure. Many theories have been advanced which do not satisfactorily explain all the cases. The fact that so many synonymous terms, such as atelectatic bronchiectasis, congenital bronchiectasis, telangiectatica, bronchiolectasis, fetal bronchiectasis, congenital cystic malformation of the lung, honeycombed lung, etc., have been used to describe various cases indicates the different interpretations placed on the nature and origin of the pathologic condition. Some observers even question the fact that all cases are congenital, yet the evidence is overwhelmingly in favor of such a conclusion. A brief résumé of the various theories of some prominent authors follows.

The condition was described by Heller (7), in 1885, as a congenital atelectasis, due to the failure of the normal lung at birth to expand, which results in the lack of alveolar development, compensated by the widening of the neighboring bronchi. Francke (22) also reported his case as a congenital

atelectasis Atelectatic bronchiectasis or aplasia of the alveoli is recorded in the cases described by Orth (23), Heuter (24), and others

the cysts, the later, the more numerous and smaller, so that some lungs have a honeycombed appearance Swanson, Platou, and Sadler (17), in 1928, agreed with

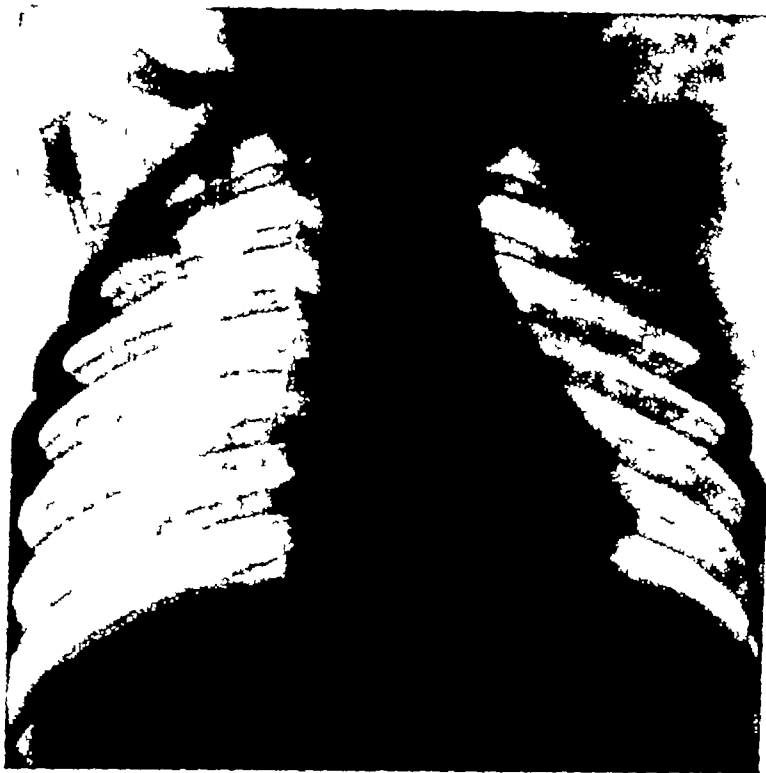


Fig 5 Roentgenogram taken on Aug 17, 1934 The air cyst and its surrounding wall are entirely gone The lung-field is clear and the peribronchial markings are not exaggerated or pronounced, and appear to be the same as on the left.

In 1862, Virchow (25) considered the pathogenesis as dilatations of the lymphatics The mesothelium-lined cysts scattered through the interstitial pulmonary tissue were regarded by Klebs (26) as lymphangiectatic These defects of aplasia and hypoplasia are caused by a developmental error Grawitz (11), in 1880, described the lesion as a congenital bronchiectasis due to faulty anlagen of the lymph-vessel system of the corresponding lobes of the lung

In 1914, Heuter (24) believed that the lesion is the result of a stenosis or closing off of the bronchial branches The earlier the process develops, the fewer and larger

Heuter that the developmental error is probably a stenosis of a bronchus or bronchiole, claiming that the secretions in a cyst can cause marked distention and distressing symptoms Miller (27) questioned the rationale of this theory, maintaining that a retention of secretion, the escape of which is blocked by strictures of the bronchioles, can hardly be the actual cause This assumption is substantiated by the fact that a communication with a bronchus is frequently demonstrated, the epithelium is not always flattened, there is no apparent pressure atrophy of the intervening septa, and the secretion found in the cavity is not sufficient in amount to cause distention

Koontz (1) noted that the cyst is caused by a constriction of the walls of the bronchus with a dilatation of the parts distal thereto. The basis for the excessive development of the mucous membrane, which forms the constriction in the bronchus, was unknown to him and is evidently a developmental anomaly. Microscopically, he noted two general types: cysts which appear like bronchial retentions, with concentric muscle fibers and cartilage in their walls, which are lined with stratified ciliated columnar epithelium, and cavities which resemble emphysematous blebs lying subpleurally. Although most cases are lined with ciliated polygonal epithelium, many other types of epithelium have been described, as cuboidal cylindrical with or without cilia. Small and medium-sized cysts are principally lined with many-layered ciliated columnar epithelium, whereas the larger ones have flat or cuboidal cells. Elastic and fibrous tissue, smooth muscle, and pieces of cartilage are also generally found. Clear albuminous fluid, desquamated epithelial cells, lymphocytes, pus, or mucus in the lumen of the cavities are often found in different cases. The absence of pigment or anthracosis is an important finding which indicates the congenital origin of the lesion.

Koontz made the observation that often an excess of elastic tissue and smooth muscle frequently appears in tumor-like masses. In 1897, Stoerk (28) believed that fetal bronchiectasis is due either to an inflammation which produces bronchial stenosis, with a retention of the secretions, or to an increase of the interstitial or peribronchial fibrous tissue which retains its fetal characters. He considered the lesion as neoplastic and termed it fetal cystic bronchial adenoma. In Huckel's (12) first case of cystic disease in a stillborn, he described the presence of glandular proliferations invaginating the cystic cavity, and regarded the pathology as resembling bronchial adenoma. In 1929, Altmann (29) described the excessive growth of the interstitial connective tissue. Lohlein (30) was of the belief that the process is neoplastic. Cystic

adenomatous malformations in a six-day-old infant were described by Couvelaire (31). Buchmann (32) noted epithelial and muscular proliferation, which he interpreted as neoplastic transformations. Although in certain of the cases collapsed tubular epithelial projections into the cystic cavity resembling glands are described, structures which provoked Stoerk's suggestion that the lesion is adenomatous in character, nevertheless, Miller (27) regarded their occurrence as apparently not constant and not an essential part of the lesion.

The French observers were inclined to regard congenital syphilis as the underlying cause. In 1907, Sandoz (33) believed that the faulty development of the alveoli from the small end-bulbs of the bronchial tree in the embryo is due to congenital syphilis. Oudendal (34), in 1928, considered the developmental anomaly to be caused by fetal adhesions between the parietal and visceral pleurae, fetal infection with syphilis being given as the possible cause of these adhesions. He did not consider neoplasm as the likely etiology. However, since syphilis is frequently absent, this impression is not tenable.

The British authors did not regard the condition as of congenital origin. In 1907, Box (35) believed that the lesion developed as a sequel to bronchopneumonia. Bernstein's (36) theory expressed a similar belief, in which he stated that the following sequence of events takes place: acute bronchitis, bronchiolitis, peribronchitis, bronchopneumonia ending in dilatation of the terminal bronchioles, and infundibula. However, the present consensus of the investigators is that cavities obviously result from an anomaly in development rather than from an acquired disease as bronchopneumonia. Although these patients have an increased susceptibility to intercurrent disease due to their congenital lesion and may die of pneumonic infection, it does not necessarily follow that the cysts are the result of this infection. On the other hand, it is more likely that pneumonia not infrequently complicates the underlying cystic

condition which completely masks the basic lesion for a time, as occurred in Eloesser's (37) case. Of the 86 cases reported in infants and children who were subjected to autopsy, only 25 showed pneumonic lesions. The necropsies of patients reported by Ribadeau-Dumas and Rault (38), Hückel (12), Wood (39), Fleming (40), Cautley (41), Wolman (9), Pappenheimer (2) and others showed no evidence of inflammatory changes.

Other theories as to the causative factors in the development of pulmonary cysts have been expounded. In 1927, Sauerbruch (42) mentioned the possibility of pressure and constriction across the hilus of the embryonal lung-bud by a duct of Cuvier occurring early in development. Smith (15) believed that dilatations of the atria, the openings into the bulbous terminations of the bronchioles, to be the cause, since he found no elastic or muscle fibers in the walls of the cyst on microscopic examination. The malformation was not recent enough in origin to be dilated alveoli, because these cells are not formed until the sixth fetal month. De Lange's (43) theory, expressed in 1927, considers the etiologic basis as an underdevelopment of the alveoli, which is compensated for by a widening of the bronchi. This developmental error involving the alveolar tissue interferes with the normal support of the bronchi, as a result of which they become unduly dilated.

Miller (27), in 1926, was of the opinion that the change affects the finer bronchioles, but not the larger bronchial branches, thus distinguishing cysts from bronchiectasis. Even though a certain amount of smooth muscle and cartilage is found in the walls of the cysts and is scattered through the intervening tissues, nevertheless, Miller felt that the cause is entirely obscure but obviously a result of a developmental error. In 1934, Wood (39) was also inclined to believe that many of the theories advanced do not satisfactorily explain all of the cases, and that the true cause is still unknown. Nevertheless, he

was of the opinion that the origin is congenital.

In 1931, Parmelee and Apfelbach (44) believed the cyst to be an enormously dilated bronchial radicle or a huge bronchiectasis, probably developing as follows: a small congenital bronchiectatic cavity, which produces no symptoms and no abnormal physical conditions at birth, gradually increases in size as the infant breathes, resulting in a one-way valve mechanism that readily allows air to enter the sac and inflate it, but does not allow a corresponding deflation to take place. As the sac grows in size, the bronchial radicle and radicles leading to it become more and more tortuous as they are compressed toward the hilus, thereby increasing the interference with deflation. Finally, respiration and circulation are embarrassed sufficiently to produce dyspnea and cyanosis. The histologic studies indicate that in almost all cases the cyst wall has the characteristics of a bronchiole, and the defect in the development of the bronchiole is of embryologic origin. In 1932, Nelson (19) entertained similar views. He considered that the malformed bronchi, with readily collapsing walls, may become partially obstructed by increasing the intrathoracic pressure, allowing a valve-like action with the ingress but not the egress of air up to a point at which rupture of a cyst occurs, with the production of a temporary pneumothorax and an improvement in the clinical condition.

The theory advanced by Parmelee and Apfelbach (44) was also supported by Croswell and King (45). However, Anspach and Wolman (4), in 1933, criticized this explanation, and logically expressed their own views. If the cyst enlarges by forcing its way peripherally through the surrounding lung tissue within the short space of a few weeks, one would expect, therefore, to find a greatly stretched thin-walled capsule and flattened lining due to the quick increase in size. Instead, however, these cysts have the opposite structure, namely, a thick fibromuscular capsule and well developed columnar epithelial lin-

ing The probability is that they all had a similar beginning, that is, rupture of a fluid-containing cyst. The presence of a well developed wall and of an entering bronchiole substantiates this conclusion. Rupture and evacuation must then have occurred soon after birth. In Anspach and Wolman's study of the pathogenesis, most cysts possess a lining of cuboidal epithelium supported by fibrous tissue, smooth muscle, and cartilage, and seem to be bronchogenic in character. The histology resembles a lymphangioma ramifying through the alveolar septa. The primary pathologic picture is often confused by the complications within the lung cyst, as infection, rupture, etc. Anspach and Wolman maintained that "cysts found in early infancy are true congenital malformations, arising from several different sources in embryonic life. However, once a large cystic cavity has been formed, its behavior should be determined largely by mechanical and accidental influences, such as capsular strength, proximity of adjacent air passages, plasticity of the surrounding lung tissue, and the presence or absence of complicating respiratory infections, rather than by its embryogenesis or histology of its lining."

Anspach and Wolman's case was originally a large fluid-filled cyst, its fluid content disappearing while under observation, presumably due to a rupture into a bronchiole. Some mucoid material was expectorated, the remainder apparently having been swallowed. The fluid in the cyst was replaced by air. Due to the valve-like effect of the bronchiolar opening, which permitted an ingress but no egress of air, the sac, instead of collapsing, dilated or ballooned out. This expansile mechanism accounted for the respiratory difficulty, which eventually caused death. These changes were followed roentgenologically, and verified at necropsy.

The writers' case can well be explained in a similar fashion, the findings fitting in so well with the above description that it appears to be the only tenable explanation. When first studied with the roentgen ray, the infant's chest showed a fluid-containing

cyst with no air. After the child coughed up thick, gelatinous material, the roentgenograms showed the presence of air and a fluid level, indicating that the cyst had ruptured into a neighboring bronchiole. However, no expansile enlargement of the cyst took place, as in Anspach and Wolman's case, because the channel between the bronchiole and the cyst was apparently patent in inspiration and expiration. The fluid, however, was entirely evacuated and replaced by air, all that remained was a solitary non-expansile air cyst. This finding remained unchanged until its walls finally collapsed and absorbed—the patient made an eventual recovery.

Symptomatology—Many cases of congenital lung cyst are symptom-free for many years, and may be unrecognized until late in life, if at all, provided that no complication or intercurrent condition ensues which necessitates a detailed physical and roentgenologic examination. The most common symptom of congenital pulmonary cysts, especially in infants and children, is the presence of recurrent attacks of dyspnea. This may be so mild as to be almost overlooked, or so severe as to cause profound fear of impending death. The severity of the breathlessness will depend on the size and type of the cyst. A solitary cyst communicating with a bronchus, which admits the air and produces a one-way valve mechanism at the opening, accounts for the most profound attacks of dyspnea, which often require thoracentesis to relieve the air tension in the cyst cavity. This is the so-called expansile or balloon air cyst, which may become very large, resulting in compression atelectasis of the surrounding lung, shifting the mediastinal contents to the opposite side, and depressing the diaphragmatic leaf. These patients usually expire in an attack. Such cases are recorded by Miller (27), Swanson, Platou, and Sadler (17), Nelson and others. Multiple cysts of the lung do not as a rule produce marked dyspnea. When bilateral and extensive, they may cause slight respiratory embarrassment, which may often pass unnoticed. The

cysts communicate with a bronchus which allows the air to pass only one way, they form a trabeculated ballooned cyst, which produces symptoms similar to those present in patients with solitary expansile cysts. The case reported by Hunermann and Sievers (46), and Miller's (27) second case, illustrate this type.

Accompanying the dyspnea, cyanosis is a prominent symptom, varying degrees of which may be observed by the parent, or discovered on examination. Cough is a very variable symptom and is often absent. It apparently never plays a very prominent part, however, cough and expectoration are important symptoms in watching the progress of a case. The sudden onset of a bout or "fit" of coughing in the infant reported by the writers, with the expectoration of thick brown fluid, is significant as it was in the case described by Anspach and Wolman (4). It indicated a rupture of the cyst into a neighboring bronchiole and the displacement of the contents of the cyst by air. The authors' case developed free communication between the cyst cavity and the bronchus and remained non-expansile. However, Anspach and Wolman's patient formed an imperfect opening which did not allow the air to escape from the cavity during expiration. The result was an expanding or balloon cyst which caused severe respiratory difficulty and eventually death.

The expectoration occasionally may be blood-tinged or frank hemoptysis may occur. Pearson (47) reported a case of hemoptysis in a girl 14 years of age with multiple cystic cavities in the left lung. Usually, however, bloody expectoration is more frequent in adults suffering with congenital bronchiectatic lesions or multiple air cysts.

Other symptoms of congenital lung cyst in children are noted in the presence of complications which oftentimes mask the congenital condition completely. Probably the main complication is the presence of pus in the cavity, which may result in an elevation of temperature, but is usually not alarming in degree because of the localization of the purulent fluid. Frequent

coughing attacks are the rule, and, if a bronchus is in communication with the locked pus, a purulent expectoration is present. The symptoms of a pneumothorax, partial or complete, are present when an expanding cyst ruptures into the pleural cavity. Among the less common symptoms of cystic lung are anorexia and vomiting, each of which was present in five patients of the entire series.

The physical signs in a large solitary cyst are different from those present in multiple cysts, the presence or absence of fluid is likewise a factor. The connection of the cavity with a bronchus with or without a free channel also affects the nature of the physical signs. Occasionally, no signs are present. Wood (39) reported a solitary non-expansile fluid cyst in a child one year of age who had no signs in the chest, the discovery of the cyst being an accidental roentgen finding. Paviot (48) described at necropsy a solitary non-expansile air cyst in a young girl who died of typhoid fever. The pulmonary lesion gave no symptoms or signs during life.

A well-developed solitary balloon cyst presents the signs of a pneumothorax. On inspection, the affected side bulges and moves poorly on respiration. The apex beat is displaced considerably. Percussion reveals hyper-resonance over the affected area and a shift of the heart and mediastinal structures to the unaffected side. Dullness over the compressed lung is usually elicited, breath sounds are diminished or even absent, and râles are often heard in the region of the compressed lung. These signs vary when air and fluid occupy the cavity, and the signs of a localized hydropneumothorax are elicited. If the cyst which contains air and fluid occupies the entire side of the chest, as in Anspach and Wolman's (4) case, the findings simulate a general hydropneumothorax.

Multiple cysts or cystic degeneration of the lung, unilateral or bilateral, present the physical findings of bronchiectasis. The signs depend on the number and size of the cavities as well as on the presence or absence of mucus or pus.

The blood picture is normal, except for a slight or moderate anemia which may or may not be present. Some degree of leukocytosis is noted in patients with infected cysts. Although malnutrition may be present (malnutrition was sufficiently evident to be recorded in 12 of the collected cases), the general condition of the patient is often good. In 20 of the infants and children, other congenital deformities were found beside the cystic malformation of the lungs. An anomalous development of the lung was the most frequent abnormality—the anomaly was usually an accessory lobe or lung which harbored the cystic defect. Diagnosis by the subjective and objective findings alone is rather difficult, and a review of the reported cases shows that the diagnosis was missed considerably more often than not. Roentgen study is by far the most reliable means of diagnosis during life, although the symptoms and signs should at least suggest the possibility and should be borne in mind when a complete roentgen examination is made.

Roentgenological Findings—The roentgen study includes not only vertical and prone views as well as a lateral study, but also a painstaking roentgenoscopic survey. The findings are single or multiple cavities with thin walls in one or both lungs, containing fluid or air or both. If sufficiently large the surrounding lung is compressed and airless. The heart and mediastinal shadows are displaced to the unaffected side, and the diaphragm is depressed on the involved side. In multiple cavities, one or both lungs appear honeycombed with trabeculated cystic areas. Differentiation from massive or localized hydropneumothorax, tuberculous cavitation, atelectasis, acquired bronchiectasis, lung abscess, encapsulated fluid and pulmonary consolidation may be difficult. The surrounding capsule with its clear-cut curvilinear borders aids in establishing the diagnosis. Lateral views show the process to lie within the lung field. Unilateral emphysema, caused by a non-opaque foreign body such as a peanut in the bronchus, especially when the foreign body produces a ball-valve effect

must, not infrequently, be excluded, and may necessitate a bronchoscopic examination. Nevertheless, a careful and thorough roentgen survey and a detailed history will in most cases, rule out these conditions and establish the diagnosis of pulmonary cysts. Before the advent of roentgenography, the condition was seldom, if ever, recognized during life. When observed on the autopsy table, it was viewed as a pathologic curiosity, and had little or no clinical significance. Wood (39), who observed 16 cases, diagnosed six entirely on the basis of the roentgenologic findings, and is of the opinion that a large percentage of all cases can be so recognized.

Diagnosis and Differentiation—The recognition of pulmonary cysts in children depends partly on the symptoms, less on the physical findings, and chiefly on the roentgen study. Recurring attacks of dyspnea with varying degrees of cyanosis are usually present in large cysts. Cough may or may not be present, and is seldom a prominent symptom. These symptoms without the history of a previous respiratory infection should put one on his guard. If the cyst is large and contains only air, hyperresonance and diminished breath sounds are elicited, the heart being displaced to the normal side. Local dullness is present and breath sounds absent when fluid fills the cavity. Small cysts may cause no symptoms or physical findings.

The roentgenologic findings are important and often establish the diagnosis. When fluid is present, the cyst appears as a dense ovoid shadow surrounded by normal lung. The diagnosis can often be confirmed by the aspiration of milky, viscid fluid, the nature of which differentiates it from encapsulated fluid from other causes. The fact that the patient is an apparently healthy infant will point more toward a lung cyst. In a large balloon air cyst, pneumothorax is to be ruled out. In the former condition a moderately thin capsule is present and the cavity lies within the lung. The surrounding lung is compressed from all sides, toward the apex, toward the base and costophrenic angles.

the lung root, which shifts with the mediastinal structures to the opposite side. In generalized pneumothorax, the air lies without the lung which collapses toward the hilus, so that the apex and sinus are free from lung tissue. The lung root and mediastinum are likewise shifted contralaterally, but the root is not thinned out as in a large lung cyst, but appears rather like a dense stump which represents the collapsed lung. In addition, no capsule surrounding the air is present. Roentgenologically, multiple cysts are recognized by their honeycombed appearance simulating acquired bronchiectasis, from which they must be differentiated. Further study by bronchoscopy and by the injection of iodized oil into the bronchial tree may be required to establish the diagnosis.

The history, symptoms, and a thorough roentgenologic investigation, occasionally requiring visualization of the bronchial tree with opaque oil and rarely necessitating bronchoscopy, will help, in almost all cases, to exclude other possibilities. Conditions such as cystic diseases of an acquired nature are to be considered and must be excluded. Echinococcal cyst appears usually in the right lower lobe, and after rupture may show characteristic hooklets in the sputum. The complement fixation test and the presence of an eosinophilia aid in their differentiation. Dermoid cysts usually begin after puberty and often originate in the anterior mediastinum. Occasionally, they rupture into a bronchus or into the pleural cavity or the lung itself. Dermoid cysts, teratomas of the mediastinum, and mediastinal cysts occur most frequently in the third decade of life and form dense adhesions to the neighboring structures. In a case of a dermoid cyst, the presence of teeth or bone may be demonstrated on the roentgenogram, or hair may be found in the expectorated material. Hydatid cysts are also usually mediastinal in location and produce little dyspnea. If rupture occurs, the watery nature of the fluid is rather characteristic, and hooklets and fragments of membrane may be present in the expectoration. Congenital

pneumothorax is an extremely rare condition and can be differentiated from a huge solitary balloon air cyst in the same manner as acquired generalized pneumothorax, discussed above. Solid tumors may offer some difficulty at first. A chondroma or a ganglioneuroma presents sharp borders and is seldom confused with a cyst filled with fluid, the borders of which are rather poorly defined. Occasionally, it is necessary to induce a pneumothorax to establish the diagnosis. This procedure was employed in two of Wood's (39) patients with telling effect. The outline of the cyst within the partially collapsed lung is clearly portrayed and easily recognized. The patients reported by Hunermann and Sievers (46), and by Swanson, Platou, and Sadler (17) also demonstrate the lung cyst in the presence of an induced pneumothorax. Diaphragmatic hernia or eventration can readily be excluded by means of the oral administration of barium. In addition, the physical signs vary and gurgling sounds are frequently heard in the patient with the herniated lesion.

Prognosis—An analysis of the reported cases clearly shows a high mortality in infants and children. In the 51 cases of congenital cystic diseases in infants and children collected since 1925, 35 are dead. The patients reported by Crowell and King (45), Vollmer (49), Zarfl (50), and the new case described in this communication are the only four on record that have completely recovered and show no trace of the former condition roentgenologically. There are patients, however, who live for years with few or no symptoms, but with no change in the roentgen appearance of the cyst. Several adult patients have been cured by the surgical removal of the cyst, but, because of their age, surgery has not been attempted on infants and young children. Melchior (13) removed successfully what he considered to be a dermoid cyst in the left lung of an eight-year-old girl. On examination, the cystic tumor proved to be a congenital tracheo-bronchial cyst. Although adults may live for many years with pulmonary cysts, in infants the condition presents the

gravest outlook and frequently results in early death

Treatment—No specific treatment can be offered. Many cases present a surgical problem, and future thoracic surgery in infants and children must meet the challenge. Thoracentesis has been performed, with temporary improvement, and a one-way cannula which permits only the exit of air has been left *in situ* for several days, a procedure which is of only transitory benefit. Such a cannula was employed by Miller (27), Swanson and his co-workers (17), and others, with temporary relief. Crosswell and King's (45) case had repeated aspirations with a one-way tube, and recovered. Although Vollmer's (49) patient had one aspiration after which the cyst eventually disappeared, the author did not believe that the thoracentesis should be credited with the cure. In Zarfi's patient, who was a seven-months-old boy with a solitary air cyst, puncture was almost decided upon when the symptoms began to subside and thus intervention was rendered superfluous. The child experienced three severe episodes of high remittent fever, and exhibited diffuse râles in the chest. These attacks, which lasted from three to eight weeks, occurred in rapid succession. With the subsidence of the symptoms, the cyst appeared reduced in size and, finally, disappeared entirely five months later. The writers' patient recovered without any treatment. Inasmuch as many of these children live only a short time, with or without repeated thoracentesis, a reliable therapeutic procedure is in order. There is no treatment in the diffuse honeycombed type of cysts.

SUMMARY

Stimulated by the recent literature more and more cases of congenital lung cysts have been reported in the last decade. Although their etiology is still obscure the opinion prevails that we are dealing with a congenital malformation or developmental error, which results in a dilatation of the terminal bronchiole filled with a tenacious glairy fluid. If the cyst communicates with

an adjacent bronchiole, this fluid is replaced by air, and may remain stationary in size, provided the communication is patent during both phases of respiration. If the air is allowed to enter the cystic cavity, and the communicating channel collapses or is closed off during the expiratory phase, the cyst enlarges or balloons, thereby producing severe attacks of dyspnea and cyanosis, which often terminate in death. A similar mechanism obtains in the case of multiple or honeycombed cysts.

The diagnosis is made chiefly from a complete roentgenologic survey, and the condition must be differentiated from general or localized pneumothorax, lung abscess, encapsulated fluid, pneumonia, solid tumors, and acquired cystic disease such as bronchiectasia, echinococcic cyst, and hydatid cyst. The prognosis is very grave, especially in infants, and only four cases are recorded to have made a complete spontaneous recovery. No specific treatment can be offered, although the opinion is expressed that surgical removal will some day be a feasible procedure.

CONCLUSION

A case of congenital solitary lung cyst in an infant is reported. The cyst ruptured into a neighboring bronchus, evacuated its fluid contents, which were replaced by air. Subsequently, the cyst walls collapsed and were absorbed, with the infant making a complete recovery.

The literature on congenital lung cyst is reviewed, and the various theories of its pathogenesis are outlined and discussed. A logical classification for this anomaly, suggested by Anspach and Wolman, is presented. The symptomatology, diagnosis, differential diagnosis, prognosis, and treatment are discussed as completely as our present knowledge on the subject permits.

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GRAPHICAL METHOD FOR OBTAINING THE AREA OF THE HEART SHADOW IN THE ROENTGEN-RAY STUDY OF HEART DISEASE

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CLINICIANS for the most part agree that the size of the heart is a good index to its anatomical and functional status, consequently, accurate determination of the size of the heart in relation to cardiac disease has been a subject of considerable importance. The size of the heart may be determined by the following methods: percussion, palpation, and the roentgen ray.

By percussion it is possible to outline the left border of the heart and the width of the upper sub-sternal dullness, but it is very difficult to determine the right border of the heart. However, under normal conditions the determinations may be relatively accurate, but if the individual is obese and deep-chested or if an emphysematous thorax is present, this method is of little value, because percussion usually includes a certain portion of the lateral surface of the heart.

Bedford and Treadgold (2) believe that the only clinical method of any particular value in determining heart size is the location of the apex-beat by palpation. The procedure they advise is the location of the place on the chest wall at which a definite lift is imparted to the finger tip, and not the point farthest to the left at which the cardiac pulsation is perceptible. This determination must be made when the heart is beating at a normal rate, and quietly, because in the presence of anemia, or Graves' disease, the apex beat will be more diffuse, and consequently the size of the heart will be increased. This method is applicable in subjects of normal build, but it is very inaccurate in the obese types or in those possessing emphysematous chests, for the larger the heart the less reliable will be the clinical apex beat as an index of actual size. The roentgen ray offers the opportunity of viewing the heart from every angle, and

various planes of the cardiac silhouette which may be performed in the following several ways:

- 1 The heart may be visualized in various positions with the aid of the fluoroscopic screen. By this method it is possible to note the size of the chest, rhythm, regularity, amplitude, and motility of the heart in various postures and during respiratory phases, but actual measurement is impossible and a permanent record is not available (2 and 3).

- 2 A film of the chest may be obtained at a distance of six or more feet from the focal point of the x-ray tube, with the patient in various positions. In ordinary cardiac roentgenology, these two methods are usually sufficient and offer the additional advantage of an objective record with the shortest expenditure of time (14).

- 3 Orthodiagraphic tracings of the heart borders and the internal surface of the thorax in various positions are used extensively.

- 4 Teleradiography involves taking a radiogram of the chest with the film two meters from the tube.

- 5 Palmieri (13) suggests making a plastic model of the heart carried out in two different phases, the first, consisting of roentgen photographs taken with artistic technique in the different radiating directions, and the second, consisting of plastic synthesis.

- 6 Klason (10) recommends orthoprojection of the heart registered on a horizontal plane, with the patient in an upright position. By comparing the projections thus obtained with an ordinary orthodiagram a good idea is obtained of the relative sizes of the four chambers of the heart. This method has its greatest

value when it is a question of estimating the size and shape of the ventricles

7 A new method which is called orthophotography, devised by Tamiya (15), is based on the principle that a specially constructed tube emits roentgen rays in two opposite directions, one beam being used for the actual roentgenoscopy, while the other registers the findings on a roentgen film mounted on the back of the tube box. This permits the tracing of the borders of the heart on the screen (orthodiagraphy) and the simultaneous registration on the roentgen film (orthophotography)

In general, the above-mentioned methods are most commonly used, giving preference to orthodiagrams in the determination of the size of the heart. The frontal plane of the cardiac silhouette is the surface evaluated with an estimation of the volume, size of heart cavities, determination of diameters, area of the surface of the shadow, and the latter two often correlated with body measurements.

The following consists of brief statements of various methods and determinations. An estimation of the volume of the heart is proposed by Kahlstorf (9), with the following formula $V = Ftk$, F being the surface of the sagittal orthodiagram, t , the largest depth of the heart evaluated by using frontal direction rays, k , an empirically determined constant figure, 0.63, which, corresponding to the shape of the heart, lies between figures for an ellipsoid and a paraboloid. From this, the cardiac quotient is estimated, which is the volume of the heart expressed in cubic centimeters, divided by the body weight in kilograms. This quotient for normal men should not be below eight and in women not below seven. It is the author's opinion that the cardiac quotient furnishes quick information concerning the size of the heart and is of considerable value in differential diagnosis in borderline cases.

Chaumet (3) proposes the following procedure for the determination of heart size. (1) Orthodiagram of the heart, with determination of the index of the develop-

ment of the depth of the ventricle, (2) total index of the left ventricle, (3) index of the right cavities, (4) surface. He believes that this method is rapid and convenient, for a few numerical figures express the respective development of various cavities.

Vaquez and Bordet (16) suggest the following two methods of determination of cardiac size. (1) By measure of the area of projection either by means of a planimeter or a sheet of paper ruled in millimeters on which one traces the figure and counts the number of square millimeters to which it corresponds, (2) by the length of the principal diameters, that is, longitudinal, transverse, and a diameter extending from the base of the left ventricle to the right cardio-diaphragmatic angle.

Host (8) devised a chart and correlated the transverse diameter, longitudinal diameter, width of the heart, surface, height, and body weight. He determined the surface of the heart by the rectangular figure constructed by the base as the longitudinal diameter of the heart, and the height by the width of the heart. He stated that comparative measures show that the surface of such a rectangle corresponds to the actual surface of the heart.

By completing the upper and the lower borders of the cardiac silhouette with the convex line, Moritz (11) believes that determining the surface area by planimeter is more important and has a greater value. However, he offers another method of estimating the surface area of the silhouette by the cardiac rectangle, which can be figured from the rectangular figure formed by the longitudinal and transverse diameters. Moritz then compares the surface area of the heart to other standard measurements of the body, such as height and ideal body weight. He states that the most constant results are obtained by comparing the surface area of the heart to the product of the height and circumference of the chest. The coefficient in 15 normal cases gave the average value as 20.1. In order to simplify things, 20.1 was considered equal to 100, thus all values were

expressed in relationship to 100. The minimum value in normal cases was taken as 86 and the maximum as 112. In pathologic cases the variation was between 112 and 180.

In further work by Moritz (12), he believed an increase in the body height was accompanied by an increase in the longitudinal and transverse diameter of the heart. The average longitudinal diameter of the heart was 14.2, the average transverse diameter 10.9 centimeters. He is of the opinion that the height of the body is a suitable measure for establishing a ratio to the longitudinal diameter of the heart.

Bedford and Treadgold (2) also correlate heart size with body size, their conclusions being as follows:

"The total transverse diameter is the most reliable index of heart size for practical purposes. Transverse diameter varies directly with body weight but not with height. At any given weight, transverse diameter varies inversely with height. Further, the normal transverse diameter may be predicted with reasonable accuracy from body weight in those [persons] whose height and weight must be taken into account in predicting heart size. This may be done by using tables based on formula, such as those constructed by Eyster and his co-workers, or the normal transverse diameter predicted from body weight may be corrected for height when this diverges from the ideal height for body weight."

Tables predicting cardiac area and transverse cardiac diameter have been prepared, based on body weight, stature, and age. Hodges and Eyster (7) computed the prediction formula for cardiac area from the measurements of 70 cases, as follows: $\text{Area in sq cm} = \text{age } 0.0204 + \text{stature } 0.8668 + \text{weight } 0.337$ minus the constant 0.38019. They concluded that if the heart is found to be 7 sq cm larger than the predicted area, the chances are 3 to 1 that it is actually enlarged.

Hodges and Eyster (6) prepared a table for the determination of normal transverse cardiac diameter derived from the following formula: $TD = 0.1094 \times A - 0.1941 \times H + 0.8179 \times W$ 95.8625, in which TD equals transverse diameter, A

age, H height, and W weight. They believed that if the heart is found to be 5 mm wider in its greatest transverse diameter than the diameter, as predicted by the formula, the chances are 3 to 1 that the widening is pathologic.

These determinations were applied in a study of 424 cases of normals and cases with chronic heart disease, and it was found that measurements in clinical hypertrophy differ sufficiently from the normal to conclude that cardiac measurement is a valuable method for determining the existence of cardiac hypertrophy, and compares favorably with other useful methods applied to clinical medicine (4). In the normal series of cases only 9 per cent exceeded the prediction by more than 10 per cent, while in the pathologic cases 94 cases were more than 10 per cent above the predicted normal area. On the basis of the greatest transverse diameter, less marked separation could be made (5). These tables afford quick determination of the predicted dimensions, and to further simplify matters a slide rule has been devised which is time-conserving and very easily read.

Bainton (1) believes the prediction tables of Hodges and Eyster to be a fairly satisfactory guide in judging abnormality in the size of the male heart and in estimating the degree of enlargement, also, that the adjusted standard for females in which the figures for males is reduced by 0.8 cm is equally satisfactory.

As has been previously stated, Moritz (11) and Eyster (5) believed the area of the cardiac shadow to be a very valuable estimation. Briefly summarizing, it may be determined by any of the following methods: planimeter, cardiac triangle, prediction formula based on body measurements, and calculation on millimeter paper.

The following is a graphic method for obtaining the area of the cardiac silhouette which is comparable with all others. The accuracy of the area thus obtained is sufficient for any case, and the cost of equipment is practically negligible.

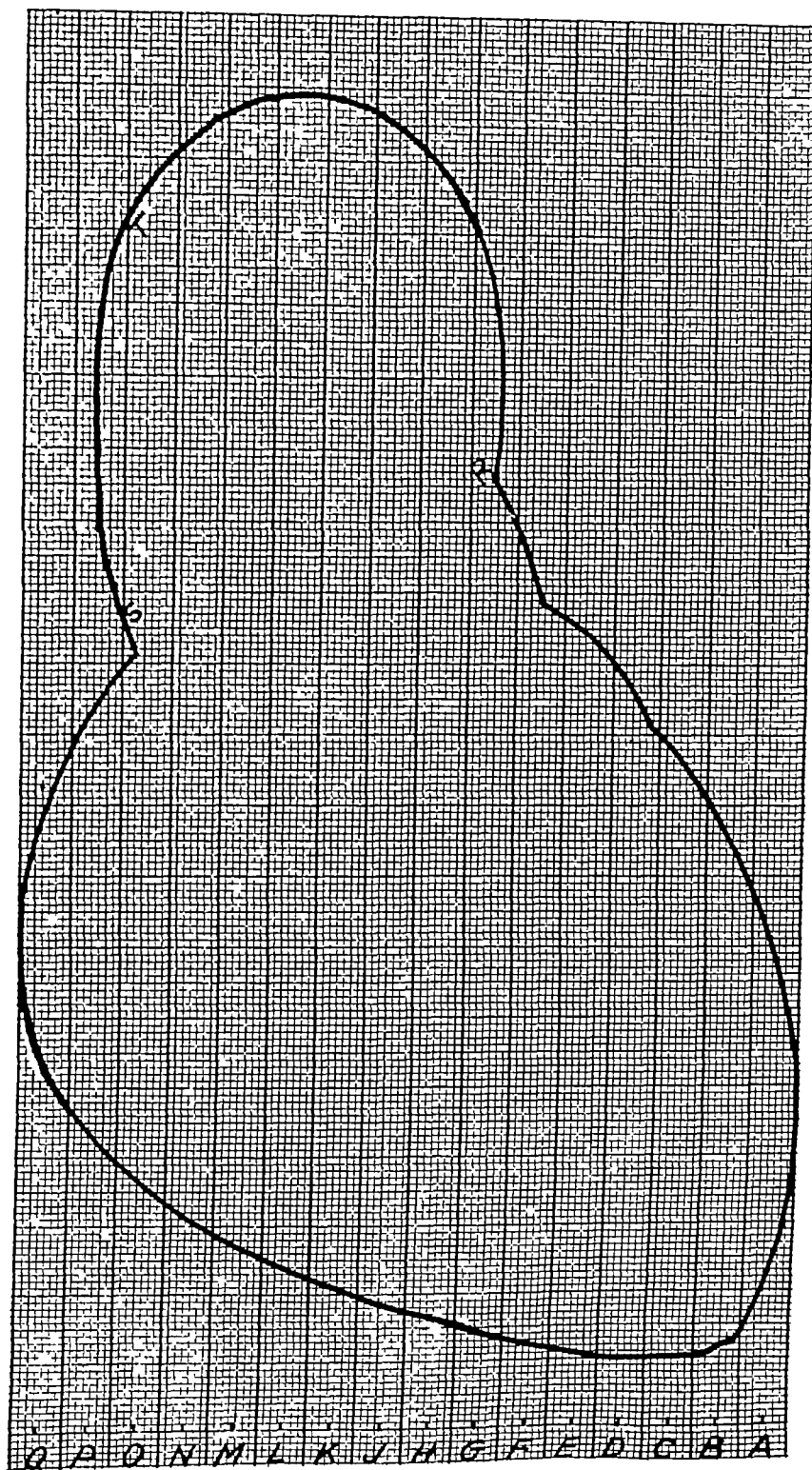


Fig 1 Geometrical drawing of aortic and cardiac shadow showing spacing arranged so as to compute area in centimeters This may be used for any irregular surface

The areas of irregular surfaces may be determined by Simpson's rule. The rectangular co-ordinate is placed over the heart shadow with the lines running vertically and horizontally, and with one of the heavy horizontal lines being tangent to the shadow at the apex. The upper and the lower borders of the heart are filled in arbitrarily. The heart shadow in this instance is divided into 16 equal strips (Fig 1), but there may be any number for convenience. The readings are taken of the mean ordinates, that is, the ordinates in the middle of the strips. In Table I, the mean ordinates are added and multiplied by the width of the strip—7 mm—which result is the required area.

TABLE I—READINGS OF THE MEAN ORDINATES OF THE HEART SHADOW

Mean ordinate	Length of mean ordinate in mm	
A	41	
B	71	
C	85	
D	95	Nearly half of
E	103	strip is cut off
F	110	
G	136	
H	162	Reading up to
J	165	$R = 121 + \frac{1}{2}$
K	166	of length above
L	164	$R = 121 + \frac{1}{2}$
M	159	of 20 = $135\frac{1}{2}$
N	151	136
O	138	
P	58	
Q	33	
	1837	

Area in sq mm = 1837×7 + area between S and T
 Area between S and T may be taken as 2 mm wide and 25 mm mean ordinate or 50 sq mm. Therefore the total area is

Area in sq mm = $(1837 \times 7) + 50 = 12909$

Area in sq mm = $\frac{12909}{100} = 129.09$

The other methods for determining area by the heart shadow rectangular method are (1) Calculating the length of the even and odd ordinates separately and computing the results as above, or (2), which is a more complicated procedure,

consisting of determining the areas of all the trapezoids and adding them. In addition, the polar method may also be used as a check on the entire area of the heart shadow including the aorta, as obtained by the rectangular co-ordinates, and especially to separate the area of the aorta from that of the heart shadow proper. All of these methods will give the same result, but the first method is by far the easiest and the least complicated.

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CHANGES IN SUSCEPTIBILITY OF *DROSOPHILA* EGGS TO X-RAYS

II CORRELATION OF BIOLOGICAL ACTIVITY AND RADIOSENSITIVITY

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WHY tissues and cells are differentially susceptible to radiation is one of the fundamental questions in radiology. It is a remarkable fact that some cells can withstand very large doses of radiation while others succumb to very small doses. For example, Crowther (1) has shown that around 80,000 roentgens of x-rays are required to inactivate a certain protozoan (*Colpidium*), whereas Scott (2) has found that cells of the chick allantois are destroyed by two or three roentgens. Although the tissues of the human body probably do not manifest such wide differences in radiosensitivity, they do nevertheless differ considerably and it is largely upon this condition that the beneficial results obtained in radiotherapy depend.

In an earlier report (3) we have shown that the radiosensitivity of *Drosophila melanogaster* (fruit fly) eggs changes abruptly and over wide ranges during early development, and have also pointed out the bearing such changes have on quantitative radiobiological results. Since the nature of developmental activity is different at different stages it has been possible also to correlate changes in radiosensitivity with changes in biologic activity and thus ascertain what conditions in the organism are associated with radiosensitivity. Such procedure has yielded information concerning the factors which determine susceptibility to radiation. Therefore, we wish at this time, to take up in some detail the biological conditions at the different stages and show their relation to radiosensitivity.

Early Development in Drosophila Eggs — The mature *Drosophila* egg consists of a cell wall or vitelline membrane within which are the single egg nucleus and many yolk granules suspended in a semi-fluid protoplasm

(Fig 1-A). Surrounding the egg is the egg case or chorion which is secreted by ovarian cells and which is lost at the time of hatching. As the eggs pass through the vagina of the female fly they are capable of being fertilized by spermatozoa which have been stored by the male in the seminal receptacle. Sperm enter the egg and one sperm nucleus unites with the egg nucleus to form the segmentation nucleus. The segmentation nucleus, lying free among the yolk granules, is surrounded by a small volume of ooplasm and gives rise to other nuclei by mitosis. Nuclei only are involved in the early cleavages, cell membranes not being present. The cleavages are synchronous among the cells and take place at the rate of one every 10 to 12 minutes at room temperature, 22° to 25° C.

At the 256 cell stage (eighth cleavage) the nuclei begin to migrate to the periphery where cell membranes are formed around them and where they become arranged in a single cellular layer to form the blastoderm (Fig 1-B). At this stage the germ cells are distinguishable by their larger size and location in the posterior polar region. The blastoderm thickens by continued mitosis and growth and presently gastrulation takes place (Fig 1-C₁). This marks the beginning of somatic differentiation, that is, with respect to the functional activity of the cells. From this point organogenesis proceeds by further differentiation (Fig 1, D₁, and E₁).

Biological Activity — During cleavage and blastulation one of the main functions of the organism is to increase the number of cells (nuclei) present. Since the cleavages are synchronous among the cells the total number is doubled with every division. The significance of such activity will be appreciated when it is remembered that

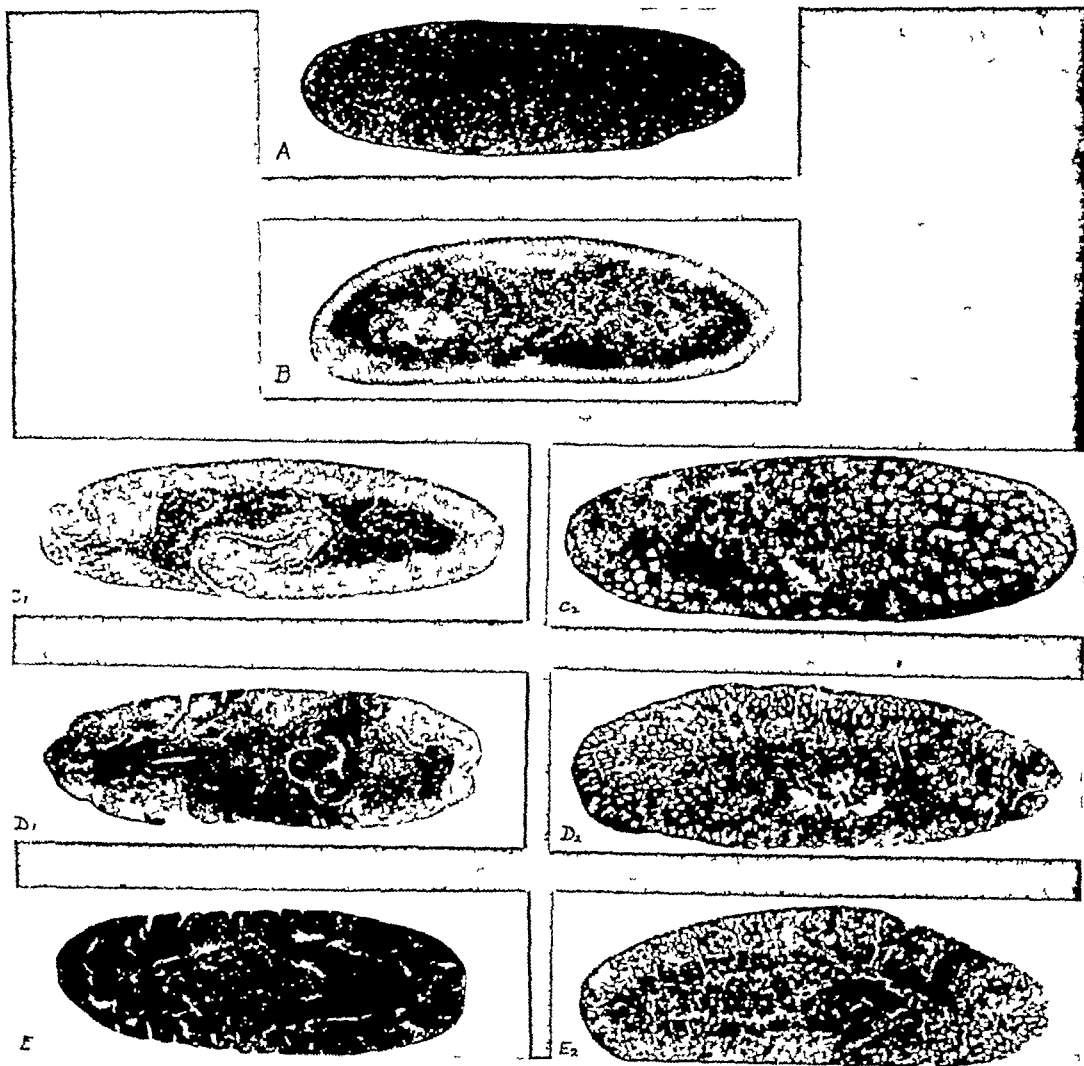


Fig 1 Sections of *Drosophila* eggs. A B C₁ D₁ and E₁ are of normal eggs at different stages in development. C D and E₂ are of eggs which received a lethal dose of X-rays during the cleavage and blastula stages and fixed from one to two hours after the usual time of gastrulation.

at the ninth cleavage, when the nuclei are moving toward the periphery, 512 cells are present and the next cleavage takes the number to 1,024, the next to more than 2,000, and the next to more than 4,000, etc. Since the cleavages take place at a fairly uniform rate, the rate of increase in the number of cells becomes faster and faster, a process characterized by the so called *compound interest law*. It may be said therefore, that the number of cells present increases exponentially with time.¹

¹ The fact that a few cells are set aside for yolk and germ cells at an early period prevents the increase from

From this it is evident that one of the first steps at the beginning of differentiation² (gastrulation) is a slowing of the rate of multiplication of cells. By examining sections of material at different stages of

being strictly exponential during the whole time of cleavage and blastulation. This however does not modify the fact that a large number of somatic cells is being doubled with every cleavage just before gastrulation which is the point of importance.

² Henceforth in this report the term *differentiation* will apply to somatic differentiation only unless otherwise stated. The few yolk and germ cells which are set aside earlier take little or no part in the development of the soma and therefore do not concern us here since the fate of the individuals and not subsequent generations is being considered.

development, it becomes apparent that after gastrulation begins the mitotic activity is localized and confined mainly to growing primordia. Thus in the instances in which several thousand cells are active in mitosis just before gastrulation, only a few are active just after. Depending on how gastrulation is accomplished (by mechanical buckling due to overcrowding of the cells in the blastoderm or by multiplication and growth of localized cells) it is possible that mitotic activity is entirely suspended for a brief period. Indeed it is obvious that the process of doubling the number of cells every few minutes cannot continue indefinitely without soon involving a volume greater than that of the entire egg, that is, unless the cells become smaller and smaller, which is not the case.

Thus three points may be emphasized. First, that during cleavage and blastulation all of the cells (somatic) are active in mitosis and the rate of increase in number present becomes faster and faster. Second, that coincident with the onset of gastrulation, which is the beginning of differentiation (functional), a very small percentage of the cells present is active in mitosis. Third, that as development proceeds in the various primordia, mitotic activity increases again.

Correlation—In Figure 2 are shown the changes in susceptibility which take place with age. The curve indicates the amount of radiation required to kill 50 per cent of the eggs in samples of different ages. At the base the stages in development are shown together with certain biologic activity which characterizes the different stages.

It will be seen that during cleavage and blastulation the organisms are relatively very susceptible to the radiation, the resistance increasing several fold at or near the time of gastrulation, and then dropping off again as differentiation gets under way.³

³ These changes have been described in much greater detail in an earlier report. It may be said in addition here however that the same results have been obtained numerous times since and that practically identical results have been obtained by Scott (2) who has studied

Hence, since the mitotic activity is highest during cleavage and blastulation, being greatly reduced at the time of gastrulation and higher again after gastrulation, some relation would seem to exist between mitotic activity and radiosensitivity. The correlation, therefore, is an exemplification of the observations made many years ago by Bergonie and Tribondeau (4) in 1906 and numerous times since by others, that the cells which are more active in mitosis and growth are more vulnerable to radiation than those which are not dividing or undergoing growth.

Mitotic Activity after Irradiation—But, having found a correlation between mitotic activity and radiosensitivity, the question arose as to the significance of this relationship. Why were the organisms more susceptible when the largest number of cells was active and least sensitive when mitotic activity was reduced? Light was shed on these questions by the investigation of one much simpler. Since the eggs were especially sensitive during cleavage and blastulation—the stage when the cells were active in division—how quickly did the cells become inactivated after receiving a lethal dose of radiation? That is, in those eggs which did not hatch, were the cells killed at once by the rays or did they continue to undergo mitosis for some time? Investigation of this disclosed a somewhat unexpected and surprising response.

Sections were prepared of eggs of different ages which had been exposed to lethal doses of radiation during cleavage and blastulation. Examination of these showed not only that the cells continued to divide after treatment but that mitosis seemed to go forward unmolested. Furthermore, organisms which had been fixed from one to two hours after the usual time of gastrulation were found to contain more than the usual number of cells and to manifest little or no differentiation (Fig 1- C_2 , D_2 , and E_2). In extreme cases practically the whole interior of the egg was found to

the changes in radiosensitivity which take place at the different stages of development in the common blue bottle fly, *Calliphora erythrocephala*.

be one solid mass of undifferentiated cells. From this it appears that death in the organisms irradiated during cleavage and blastulation was caused not by restraint of

thereby permitting cleavage to continue until too many cells were formed and preventing proper differentiation. On the basis of this observation, therefore, it ap-

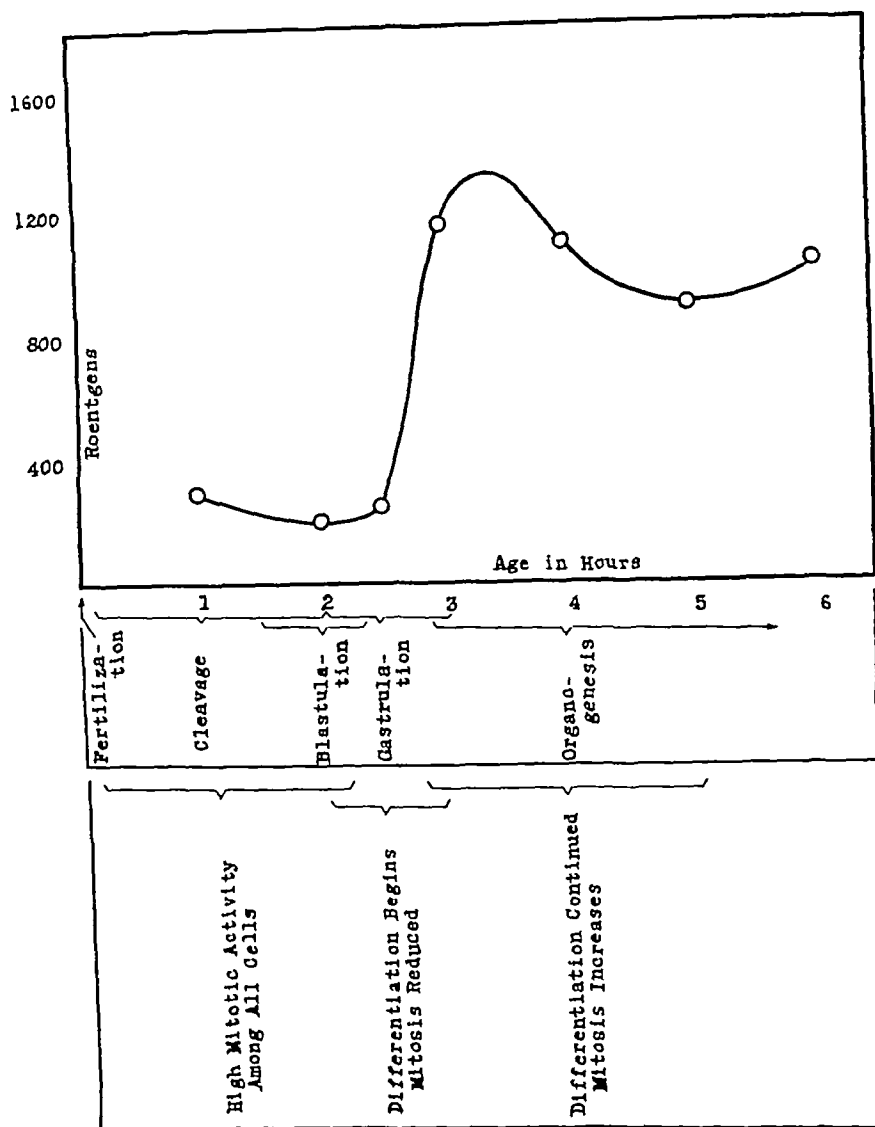


Fig 2 Curve showing the amount of radiation required to kill 50 per cent of the eggs in samples of *Drosophila* eggs of different ages. The legends beneath correlate age, stage in development and biological activity with changes in radiosensitivity.

cell growth but by excessive and uncontrolled growth. It would seem that the mechanism, which acts ordinarily to slow the cellular activity and bring about differentiation at the time of gastrulation, must have been damaged by the radiation,

thereby permitting cleavage to continue until too many cells were formed and preventing proper differentiation. On the basis of this observation, therefore, it appears that death resulting from irradiation before gastrulation is caused not so much by a direct effect on the cells, *per se*, but by an effect on the factors which normally regulate their activity.

Discussion—In the foregoing experi-

ments evidence was obtained which indicates that the lethal effect produced by radiation in *Drosophila* eggs is due in some way to modification of the factors which regulate and determine the course of development. With this information an explanation may be offered of why the organisms change so markedly in susceptibility to radiation during development.

Usually when organisms are killed by an external affecting agent, death is attributable to injury produced in the most susceptible vital part. Hence, if the dependence of the organism on such a part should cease to exist, the susceptibility would change and be determined by the next most susceptible vital part and accordingly would be greater. Thus, it may be postulated that some radiosensitive substance, or substances, or the precursor is present during cleavage and blastulation, that this substance is due to exert its influence at the time of gastrulation and bring about slowed mitotic activity and the beginning of differentiation, that having done so it is no longer essential to the organism. In such a case, the radiosensitivity after gastrulation would be determined by the next most susceptible vital part, which in *Drosophila* eggs is considerably more resistant.

These experiments, therefore, serve to direct attention beyond the fact that cells are active or quiescent in accounting for the condition of radiosensitivity. In an earlier report (5) we have determined the relative radiosensitivity of dry and germinated seeds and also of germinated seeds, growing and non-growing. As might have been expected in accordance with the observations of Bergonie and Tribondeau, the dry seeds were found to be more resistant than the germinated ones. However, in case of the germinated seeds quite the opposite was found, the radiosensitivity was the same whether growing or not. These experiments together with those for *Drosophila* eggs above illustrate well the fact that radiosensitivity is determined by the physiologic state or condition of the organism rather than its activity. It would seem that radiosensitivity and

growth activity may, in many cases, depend largely upon the same factors. This would account for the fact that susceptibility to radiation and growth activity often appear to go hand-in-hand.

That the factors which regulate differentiation in organisms may be more radiosensitive than the cells which they influence is made evident also by experiments carried out by Butler (6 and 7). Butler amputated the fore limb of *Amblystoma* larvæ and observed the influence of radiation on the regenerating appendage. Ordinarily after amputation a complete new limb is formed containing the usual number of four digits. However, upon exposure to x-rays at the proper stage during regeneration, limbs were produced which had three digits, two digits, one digit, or no digits. Butler points out that the general rules in regard to the effect of radiation on digit formation appear to be as follows: "If the limb is about to enter the two digit condition at the time irradiation is begun, then the first two digits will be formed in a manner apparently normal, but no third digit will ever develop. If the limb is in the two digit condition with the third digit about to appear at the time irradiation is begun, then the third digit will be formed apparently normal, but no fourth digit will ever develop." Butler also states "The effect of x-radiation on digit formation suggests that x-rays act on differentiating tissue at a certain critical period in the process of differentiation during which there is a heightened sensitivity to x-radiation. If differentiation has passed this critical period before irradiation is begun, then differentiation proceeds even though the animal be irradiated." With respect to differentiation, therefore, Butler's results obtained with *Amblystoma* are very similar to those we have obtained with *Drosophila* eggs in that the factors which initiate differentiation appear to be damaged.

In brief, therefore, evidence has been set forth, which suggests that in some cases at least substances which are normally present in cells to regulate and determine the nature of their physiologic activity are also

important in determining their radiosensitivity

SUMMARY

1 The radiosensitivity of *Drosophila* eggs at different stages in development has been investigated. It was found that during cleavage and blastulation the organisms were relatively very susceptible and that coincident with the onset of gastrulation the resistance suddenly increases several-fold, dropping off following gastrulation.

2 It was pointed out that during cleavage and blastulation mitosis is synchronous among the cells, divisions taking place at the rate of one every 10 to 12 minutes. Further, that gastrulation marks the beginning of differentiation (somatic) and is accompanied by a reduction of mitotic activity. The latter demonstrates the influence of important factors which regulate developmental processes.

3 Prepared sections of material, which had been given lethal doses of radiation during the most susceptible stages (cleavage and blastulation) and fixed at different times after gastrulation ordinarily takes place, showed the following: (1) that mitosis goes forward apparently unmolested after irradiation, (2) that little or no dif-

ferentiation takes place, and (3) that death is probably caused by unrestrained growth and lack of differentiation of the cells.

4 From this it is evident that one of the most important effects of radiation at this stage is a modification of the factors which regulate and control the nature of cellular activity. Accordingly, the results indicate that such regulators of activity are important, in certain cases, in determining radiosensitivity.

The writer wishes to express his indebtedness to Dr G. Failla for interest and helpful suggestions throughout the course of the work.

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PULMONARY METASTASIS A PATHOLOGIC, CLINICAL, ROENTGENOLOGIC STUDY BASED ON 78 CASES SEEN AT NECROPSY¹

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IN THE ten-year period from November, 1924, to November, 1934, pulmonary metastasis was found in 78 patients coming to autopsy at the Jefferson Hospital. Many of the patients had had roentgenograms of the chest made prior to death, thus study is based on the x-ray findings, the necropsy protocols, and the clinical histories. Most of the necropsies were per-

formed by Dr. Baxter L. Crawford, Pathologist to the hospital, or his assistant, Dr. Carl J. Bucher, though some were performed by other members of the staff.

Type of Primary Tumor—Sixty-one, or 78 per cent, of the primary tumors were classified as carcinoma, 12, or 15.3 per cent, as sarcoma, two, or 2.4 per cent, as melanoma, one as an endothelioma, one as a teratoma, and one as a thymic tumor (Table I).

Site of the Primary Tumor—The site of the primary tumor was determinable in all but five instances, the 56 carcinomas in which it was determined may be classified under six systems (Table II). The breast was the primary site in seven, or 11.4 per cent of the cases, the ductless glands in

TABLE I—TYPE OF PRIMARY TUMOR

	No	Percentage
Carcinoma	61	78.2
Sarcoma	12	15.3
Endothelioma (pleura)	1	1.2
Teratoma (testicle)	1	1.2
Melanoma (skin)	2	2.4
Thymic tumor	1	1.2
	78	

TABLE II—ORIGIN OF PRIMARY GROWTH 61 CASES OF METASTATIC CANCER

	No	Percentage		No	Lungs only
Breast	7	11.4			1
Ductless glands	4	6.5	{ Adrenal	3	1
			{ Thyroid	1	
Gastro-intestinal	21	34.4	{ Duodenum	1	1
			{ Esophagus	3	
			{ Liver	3	1
			{ Pancreas	5	
			{ Pharynx	2	
			{ Stomach	7	
Generative	8	13	Female 1 { Ovary	1	
			Male 7 { Prostate	6	2
			{ Testicle	1	
Respiratory	7	11.4	{ Bronchus	1	
			{ Larynx	3	
			{ Lung	3	
Urinary	9	14.7	{ Bladder	2	
			{ Kidney	7	2
Undetermined	5	8.1	{ Generalized	4	1
			{ Necropsy limited	1	
	61				9

¹ Presented before the Radiological Society of North America at Memphis, Tenn., Dec. 3-7, 1934.

four, or 6.5 per cent, the generative organs in eight, or 13 per cent, the respiratory



Fig 1



Fig 2

Fig 1 Metastasis from carcinoma of the breast. Numerous well defined dense deposits can be seen throughout the left lung with a large mass at the right hilum (G T female 63 years, from the service of Dr Thomas A Shallow)

Fig 2 Metastasis from adenocarcinoma of the adrenal. Numerous sharply circumscribed masses can be seen throughout both lungs (E L female 27 years a patient of Dr Elmer H Funk and Dr Reynold S Griffith) At necropsy Dr Baxter L Crawford found many sharply described nodules scattered throughout both lungs

tract in seven, or 11.4 per cent, and the urinary organs in nine, or 14.7 per cent. In four cases it was impossible to determine the primary site, and in one the necropsy was limited to the thorax.

The large number arising from the gastro-intestinal tract (21, or 34.4 per cent) is of interest and it should be noted that none had origin distal to the duodenum. In spite of the fact that the large intestines, notably the rectum, sigmoid, and descending colon are frequently the site of primary malignant disease, none of the cases in this series were from tumors arising at these sites.

One-third, or 7 per cent, of the metastasizing carcinomas of the gastro-intestinal tract had their origin in the stomach. Three were classified as adenocarcinoma, one as colloid, and one as anaplastic, in the other two the histologic structure was not specified.

The widely recognized high incidence of pulmonary metastasis from malignancy of the prostate is confirmed in this study. Of the seven cancers arising in the male generative organs, six arose in the prostate.

Analysis of the sarcomas is not so informative because of the small number of cases. The 12 sarcomas were classified according to origin as arising in the frontal sinus, neck, chest-wall, thigh, leg, lung, pleura, spleen, or uterus. According to the histologic type, they were classified as round-cell, spindle-cell, mixed-cell, lymphosarcoma, metastatic melanotic sarcoma, myosarcoma of the uterus, and sarcomatosis.

Extent of Metastasis—In nine, or 14.7 per cent, of the carcinomas, metastasis was limited to the lungs. Coupling the two cases of prostatic cancer with the two of renal cancer indicates that 44.4 per cent of the cancers in this series, which metasta-

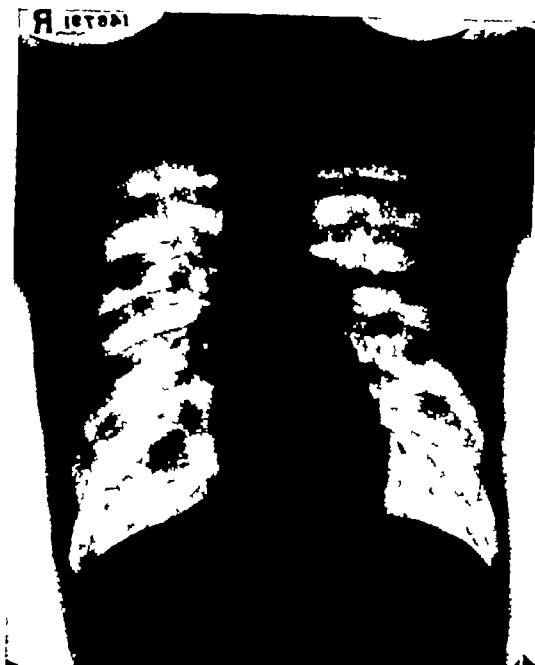


Fig 3

Fig 3 Metastasis from melanotic sarcoma—primary—on sole of foot Well defined dense nodules can be seen throughout both lungs (J D male 35 years, from the service of Dr Edward J Klopp)



Fig 4

Fig 4 Metastasis from adenocarcinoma of the pharynx Large, dense nodules are scattered throughout both lungs more numerous in bases (W S male 50 years from the service of Dr Micheal J Burns)

sized only to the lungs, had their origin in the genito-urinary organs

Metastasis was confined to the lungs in three, or 25 per cent, of the sarcomas In the sarcoma of the frontal sinus, the mixed-cell sarcoma of the leg, and the round-cell sarcoma of the thigh, the lungs were the only organs in which metastasis was found at necropsy

When metastasis was not limited to the lungs, its spread might have been almost local and confined to the regional lymph nodes or it might have been widely disseminated In one or more cases, pulmonary metastasis was accompanied by metastasis to the pleura, liver, pancreas, intestines, omentum, adrenal gland, spleen, bladder, kidney, testicle, heart, pericardium, breast, brain, dura, skin, subcutaneous structures, or skeletal muscles

Gross Pathologic Appearance—The typical lesion of pulmonary metastasis is the nodule When unaccompanied by local secondary changes or by pleural changes

the descriptions of the nodules are similar to those employed by the roentgenologist in describing their shadows

In most instances the gross nodules are firm and sharply circumscribed, though they may be hard or soft They are usually multiple and are described as being scattered throughout the lung, or the lung is said to be studded with them Sometimes they are single, and frequently they are described as being subpleural or limited to a few centimeters beneath the pleura

The size of the nodules varies from those described as miliary to those which are several centimeters in diameter Between the two limits they are frequently described as "pin-head" or "match-head" in size

The terms "shot-like," "scattered," "innumerable," "spherical," "circumscribed," "pin-head," "match-head," recur time after time in the protocols, and should be borne in mind because they are also de-



Fig 5



Fig 6

Fig 5 Metastasis from tumor of undetermined origin. Massive densities can be seen at the right root area, and throughout the right lung. One smaller mass is seen close to the left cardio-phrenic angle (L. S. male, 15 years from the service of Dr. Edward J. Klopp). A biopsy from the tumor in the right shoulder was difficult to classify while clinically it seemed to be primary. Dr. Baxter L. Crawford found it metastatic also.

Fig 6 Metastasis from adenocarcinoma of the endometrium. The left lung is evenly dense—on the original film sharply defined masses could be made out in that area. The heart is displaced to the left, and the left half of the diaphragm is elevated. A few not very dense masses in the right lung can be seen (M. G. N., female, 54 years a patient of Dr. Brooke M. Anspach).

scriptive of the lesions as seen roentgenographically (Figs 1 and 2).

The typical appearance is altered when bronchial occlusion occurs, or when massive changes take place in the pleura (Fig 5). Occlusion of the bronchus may be due to extension of a nodule into the lumen (Figs 5 and 9) or to compression of the bronchus by nodes at the hilum. Occlusion of the bronchus by metastasis to the wall is uncommon, the instance illustrated by Figure 9 was secondary to a melanoma. With occlusion of the bronchus the lung collapses and at necropsy is found to be firm, solid, and airless.

Pleural metastasis accompanying pulmonary metastasis frequently leads to the development of fluid, with compression of the lung (Fig 7). Occasionally, when metastasis is secondary to invasion of the bronchial wall by the extension of meta-

static changes from the nodes at the hilum, the lesion is described as infiltrative. However, this is an unusual form.

Clinical Features—Sex of the 78 patients, 53 (or 67.9 per cent) were males, and 25 (or 22.1 per cent) were females (Table III).

Age the decades from 40 to 60 years showed the highest incidence, 42 (or 53.8 per cent) of all patients were in these age groups. The seventh decade had the next highest incidence, 10 (or 12.8 per cent) being in this group (Table III).

Symptoms—Local symptoms due to pulmonary metastasis are few, and are determined by the extent and character of the changes, more than half the patients had no local respiratory symptoms. In 37 histories it was recorded that there were no respiratory symptoms, in six others no mention was made of respiratory symp-

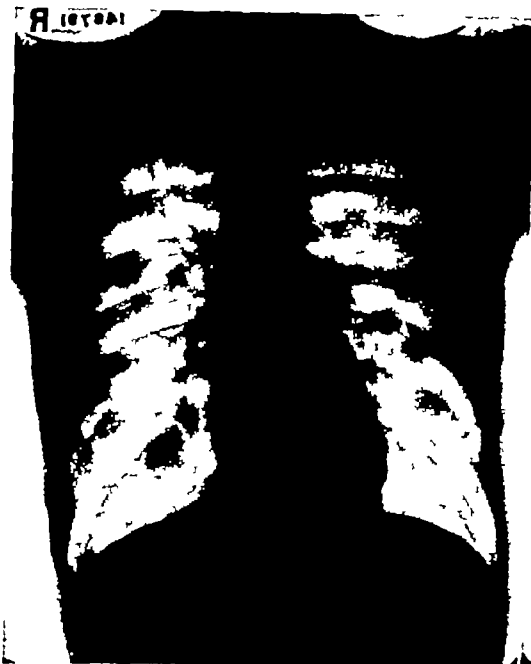


Fig 3

Fig 3 Metastasis from melanotic sarcoma—primary—on sole of foot Well defined dense nodules can be seen throughout both lungs (J D male 35 years, from the service of Dr Edward J Klopp)



Fig 4

Fig 4 Metastasis from adenocarcinoma of the pharynx Large dense nodules are scattered throughout both lungs, more numerous in bases (W S male 50 years, from the service of Dr Micheal J Burns)

sized only to the lungs, had their origin in the genito-urinary organs

Metastasis was confined to the lungs in three, or 25 per cent, of the sarcomas In the sarcoma of the frontal sinus, the mixed-cell sarcoma of the leg, and the round-cell sarcoma of the thigh, the lungs were the only organs in which metastasis was found at necropsy

When metastasis was not limited to the lungs, its spread might have been almost local and confined to the regional lymph nodes or it might have been widely disseminated In one or more cases, pulmonary metastasis was accompanied by metastasis to the pleura, liver, pancreas, intestines, omentum, adrenal gland, spleen, bladder, kidney, testicle, heart, pericardium, breast, brain, dura, skin, subcutaneous structures, or skeletal muscles

Gross Pathologic Appearance—The typical lesion of pulmonary metastasis is the nodule When unaccompanied by local secondary changes or by pleural changes

the descriptions of the nodules are similar to those employed by the roentgenologist in describing their shadows

In most instances the gross nodules are firm and sharply circumscribed, though they may be hard or soft They are usually multiple and are described as being scattered throughout the lung, or the lung is said to be studded with them Sometimes they are single, and frequently they are described as being subpleural or limited to a few centimeters beneath the pleura

The size of the nodules varies from those described as miliary to those which are several centimeters in diameter Between the two limits they are frequently described as "pin-head" or "match-head" in size

The terms "shot-like," "scattered," "innumerable," "spherical," "circumscribed," "pin-head," "match-head," recur time after time in the protocols, and should be borne in mind because they are also de-

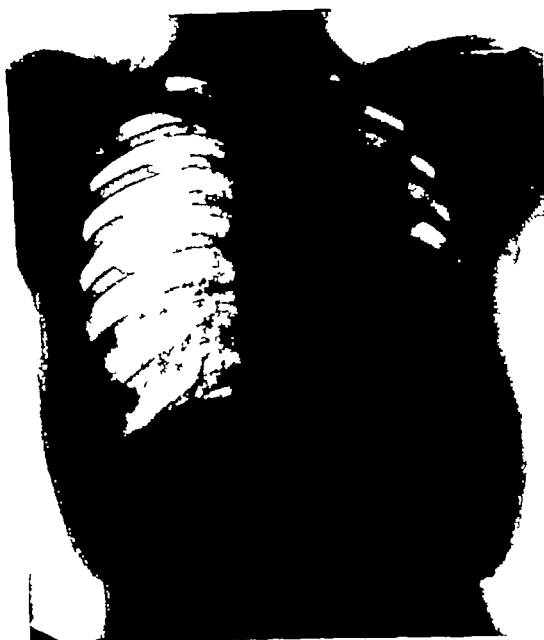


Fig 9 A

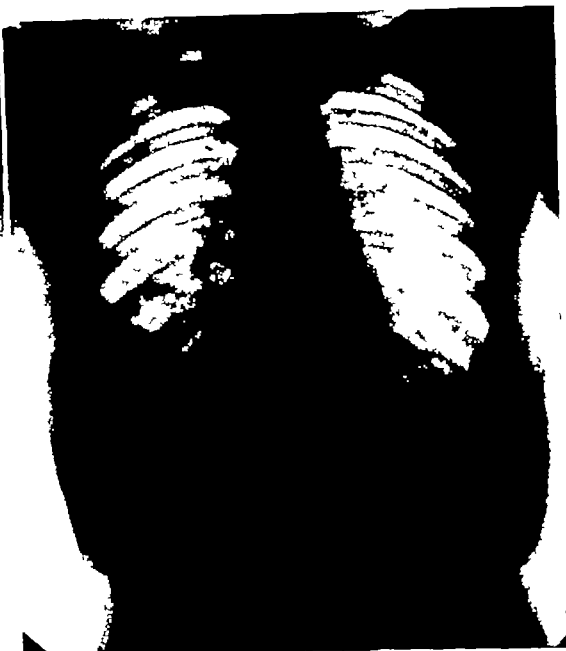


Fig 9 B

Fig 9 A Metastasis to the bronchial wall from recurrent melanoma of the skin. The lower portion of the left lung is dense, the left half of the diaphragm is elevated, and the heart is displaced to the left, due to atelectasis from occlusion of the left lower lobe bronchus by a metastatic mass in the wall (F F female, 32 years, a patient of Dr Louis H Clerf). She complained of a dry hacking cough and dyspnea. Eighteen months prior to admission a mole on her arm had been treated with an electric needle. The wound failed to heal, and six months later the area was excised, with subsequent healing. At bronchoscopy, Dr Clerf removed a piece of tissue which was diagnosed as metastatic melanoma by Dr Baxter L Crawford (cf Fig 9 B).

Fig 9 B Same patient as in Figure 9 A. There was a re-expansion of the left lung after bronchoscopic removal of a metastatic nodule from the left bronchus. The left lung is really over-distended due to the ball-valve action of the residue of the metastatic nodule still producing partial occlusion. At necropsy, 18 months after admission, Dr Crawford found several small pigmented nodules in both lungs.

expectoration also occur much more frequently in primary newgrowth. Pain occurred usually when there were massive pulmonary changes or when the pulmonary metastases were accompanied by pleural metastasis.

Duration of Life—Duration of life following the discovery of the primary tumor was determined from the history (Table V). It was possible to estimate it in 68 instances; in 10 patients, duration could not be determined with any degree of accuracy. Patients with tumors which metastasize to the lungs do not, as a rule, survive long. In this series, 35 (or 44.8 per cent) of the patients died within six months of the discovery of the primary tumor, 16 (or 20.5 per cent) survived from six months to one year, eight (or 10.2 per cent) from 12 to 18 months, and two (or 2.5 per cent)

from 18 months to two years. Of the entire group, only seven (or 8.9 per cent) were known to have survived the primary tumor for more than two years.

Roentgenographic Appearance—As the nodule is the gross morbid anatomic evidence of pulmonary metastasis, so is the shadow of the nodule typical of metastasis. The shadow of the typical pulmonary metastatic nodule appears on the roentgenogram as a round or almost round, sharply margined area of density. Usually the shadows are multiple, for in most instances the “innumerable” “spherical” “circumscribed” nodules found at necropsy are scattered throughout the entire lung or in both lungs (Figs 1, 2, 3, and 4). Sometimes they are less numerous, and occasionally there are but one or two masses (Fig 5). The size of the areas of



Fig 7

Fig 7 Adenocarcinoma of the anaplastic type of the right lung The right half of the chest is evenly dense due to fluid and tumor, left lung is grossly normal (B N female 52 years a patient of Dr S Dale Spotts) At necropsy a tumor of the right lung was found by Dr Baxter L Crawford with the lung greatly compressed by fluid in the pleural cavity and numerous miliary nodules were scattered throughout the left lung

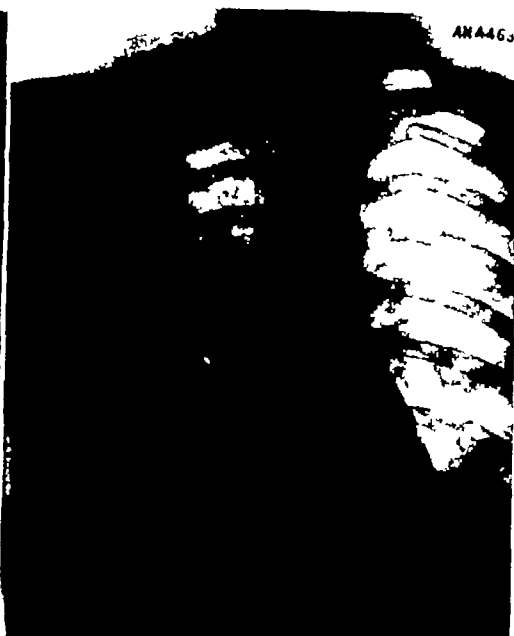


Fig 8

Fig 8 Metastasis from carcinoma of undetermined origin Markings throughout the right lung are increased and there is a slight increase in the markings at the left costophrenic angle changes resemble those of an inflammatory process (D C male 23 years, a patient of Dr Louis H Clerf) At necropsy by Dr Baxter L Crawford, done six days after this roentgenogram was made 2 000 c.c. of fluid were removed from the right pleural cavity, and numerous metastatic nodules were found throughout both lungs

TABLE III —SEX-AGE DISTRIBUTION

	No	Percentage
Males	53	67.9
Females	25	32.1
Years		
1-10	1	1.2
21-30	6	7.6
31-40	11	14.1
41-50	21	26.9
51-60	21	26.9
61-70	10	12.8
71-80	7	8.9
81-90	1	1.2

TABLE IV —SYMPTOMS

	No
Dyspnea	23
Cough	15
Pain	9
Expectoration	6
Hemoptysis	2
Hoarseness	1
None	37
Not recorded	6

55.1%

TABLE V —DURATION OF LIFE

	No	Percentage
1-6 months	35	44.8
6-12 months	16	20.5
12-18 months	8	10.2
18-24 months	2	2.5
Over 24 months	7	8.9
Unknown	10	12.8

toms though other symptoms were listed so that 43, or 55.1 per cent, of the patients had no symptoms referable to the respiratory tract (Table IV)

Dyspnea was the most frequently encountered symptom, it was recorded in 23 histories. Fifteen patients complained of cough, nine of pain in the chest, six of expectoration, two of hemoptysis, and one of hoarseness. The low incidence of hemoptysis in metastasis is in marked contrast to its high frequency in primary pulmonary neoplasm. Pain in the chest and

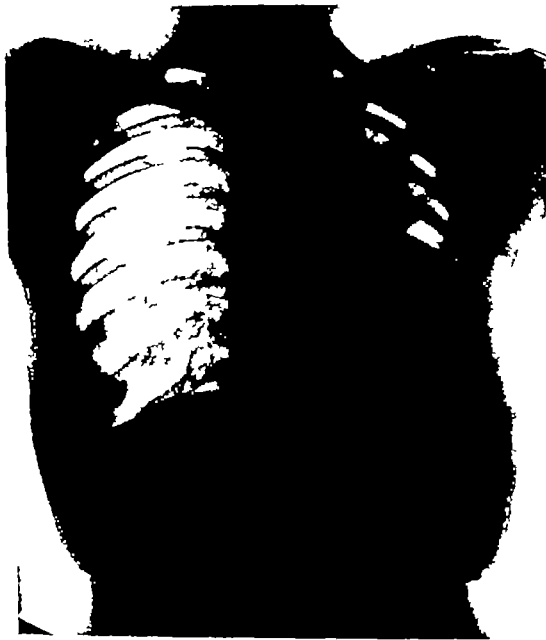


Fig 9 A

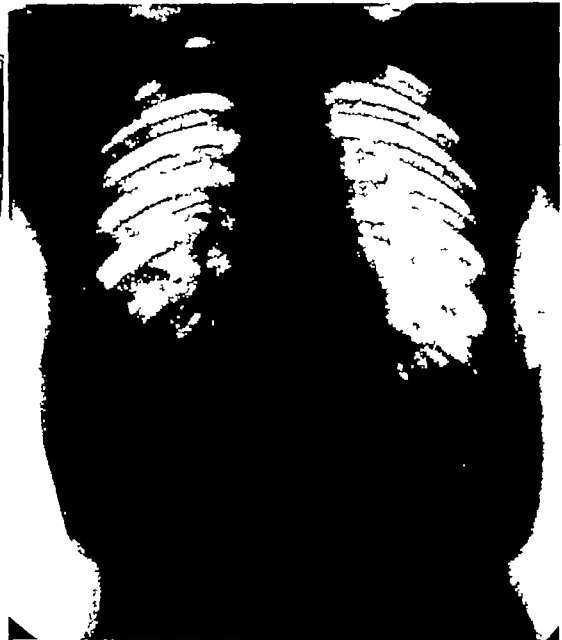


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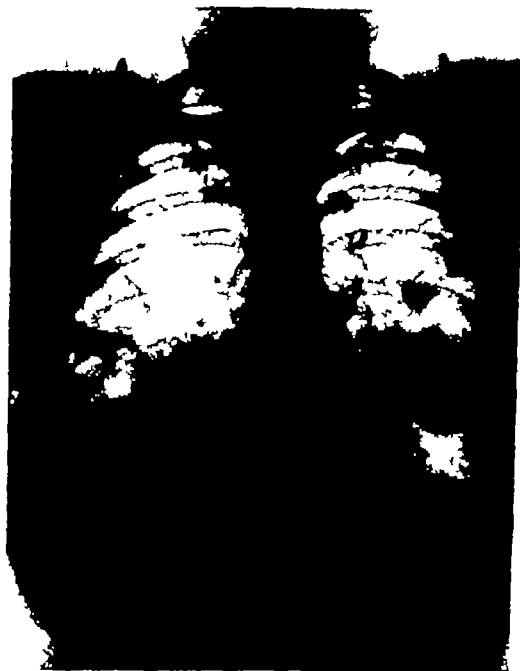


Fig 10 Metastasis from sarcoma of undetermined origin. There may be seen large sharply circumscribed annular cavities with fluid levels in the lower half of the right chest, and nodules in the left lung (L. A. female 41 years, a patient of Dr Louis H. Clerf and Dr Samuel A. Loewenberg). The patient had a cough with expectoration of mucus, of many years duration. At necropsy Dr Herbert Lund found numerous nodules throughout both lungs, some with soft centers, others containing blood. One in the right lower lobe communicated with a bronchus. The origin of the primary growth could not be determined.

density vary from a match-head to several centimeters. When innumerable, the nodules are apt to be smaller than when only a few are present.

The density of the shadow varies. When due to dense deposits, the shadows are very distinct, their densities in some instances approaching that of the heart (Fig 4), in other cases the nodules are less solid and the shadows fainter. The shadows may be scattered over both pulmonary fields or confined to one or to a part of one field.

Pleural complications and collapse of the lung due to bronchial occlusion or compression from pleural exudate alter the appearance (Fig 6). In some instances the nodules may be entirely lost in the shadow of the effusion.

Metastatic pulmonary disease is sometimes mistaken for congestive or inflammatory changes, dust changes, tubercle formation, or multiple suppurative foci. Increase in the markings described as due to congestion or to dust changes are seen when the lesion is of the type which at necropsy is described as due to miliary deposits. These changes are so nebulous that at necropsy it is sometimes difficult from the gross appearance to be sure of their exact nature.

Metastasis is mistaken for tuberculosis when the deposits vary in size and are not sharply defined. Sometimes changes in the opposite pulmonary field, due either to collapse of a lung or a part of it or to pleural exudate, mislead the observer. The history of the patient, together with the known existence of a primary tumor, may sometimes assist in reaching the proper diagnosis.

Multiple metastatic lesions rarely break down, when they do they may be mistaken for cystic disease. The multiple cavities and fluid levels seen in the sarcomatous metastasis in Figure 10 are extremely rare. Metastasis to the bronchus may produce atelectasis, as in Figures 6 and 9. In these instances, as in those cases with massive pleural changes, it may be impossible to do more than determine the character of the structural changes without being able to determine that the occluding mass is metastatic. In some instances the presence of typical metastatic nodules in the opposite lung makes the diagnosis clear.

SUMMARY

1 In 78 cases of pulmonary metastasis seen at necropsy, 61 (or 78.2 per cent) of the primary tumors were carcinomas, 12 (or 15.3 per cent) were sarcomas, two (or 2.4 per cent) were melanomas, and there was one each of teratoma, endothelioma, and thymic tumor.

2 In 73 tumors, the site of the primary tumor was found to be in one of 17 organs, in five instances the primary site could not be determined.

3 In 66, or 84.4 per cent, of the entire

series of cases, pulmonary metastasis was accompanied by metastasis to other organs. In 9, or 14.7 per cent, of the carcinomas and in 3, or 25 per cent, of the sarcomas, metastasis was limited to the lungs.

4 The typical lesion of pulmonary metastasis is the nodule. It varies in size, distribution, and density. Changes due to bronchial occlusion or to pleural effusion may hide the nodule and produce other metastatic changes described as collapse or solidification of the lung.

5 Of the patients, 53, or 67.9 per cent, were males, 25, or 22.1 per cent, were females.

6 The highest incidence of metastasis occurred in the decades from 40 to 60 years—42, or 53.8 per cent, of the patients were in this age group.

7 Local respiratory symptoms are not a prominent feature of pulmonary metastasis, 43, or 55.1 per cent, of the patients

had no respiratory symptoms. Dyspnea and cough are the symptoms most frequently encountered. In contrast to primary pulmonary neoplasm, hemoptysis is rare and expectoration infrequent.

8 Thirty-five, or 44.8 per cent, of the patients died within six months of the discovery of the primary tumor, only 7, or 8.9 per cent, were known to have survived more than two years after the discovery of the primary growth.

9 The shadow of the nodule is the typical roentgen sign of pulmonary metastasis. It is usually a sharply defined round shadow, varying in size, density, and distribution. While usually multiple, it is sometimes single or there may be only a few present. It may be obscured by pleural changes or collapse of the lung. Metastasis must be differentiated from the changes of congestion, inflammation, dust invasion, and tubercle formation.

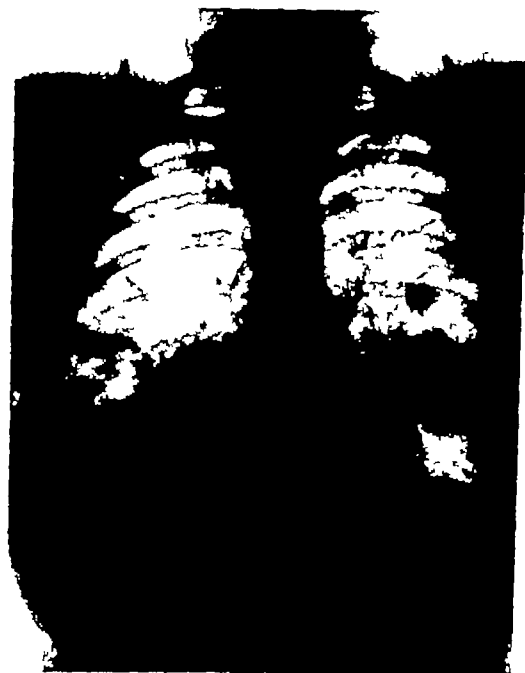


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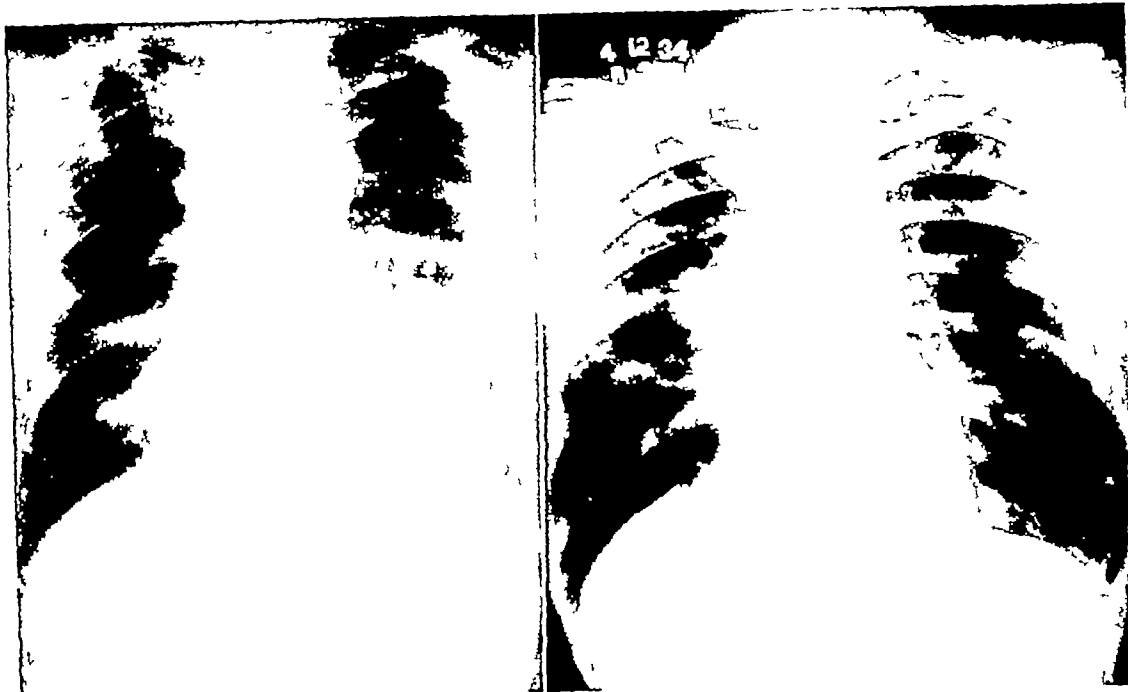


Fig 1

Fig 2

Fig 1 Case 2 (see table) Only a small shadow can be seen at the left cardiac border on the usual postero-anterior view of the chest. The tumor could be well demonstrated fluoroscopically (see text). At autopsy, six months later, the tumor occupied the entire left lower lobe—parenchymal type.

Fig 2 Case 11 (see table) Infiltrative type of bronchial carcinoma. No improvement following one protracted course of roentgen therapy. Patient died five months following this examination.

Barjohn, and Otten in recognizing two main types. More recently, Kirklin, Paterson and Vinson (11) and Farrell (6) have adopted the same classification with respect to the location of the primary shadows, namely, whether they are hilar or lobar. Kirklin and Paterson (10) also list a third group—when the condition is advanced and late and it is no longer possible to determine how or where the tumor may have had its origin.

During the early stage of bronchogenic carcinoma, while all the neoplastic tissue is endobronchial, the roentgenogram will be practically negative. Carman cited such a case and gave an illustration of the pathologic specimen. Distant metastases were present while the primary growth was still a small endobronchial plaque found with difficulty only at necropsy.

Even in the very early cases it is probable that there will be some interference with the passage of air and some obstruc-

tive emphysema. This will be overlooked unless it is specifically kept in mind during the fluoroscopic examination. Films made at the end of inspiration and expiration should also be studied. In the absence of a history of the aspiration of a foreign body such an examination is seldom made and so this earliest of signs is overlooked. No reference to the use of this method in diagnosis was found in the literature. A definite diagnosis cannot be made, but the findings should be sufficient to determine the necessity for a bronchoscopy.

Practically all bronchogenic carcinomas, however, soon reach a peribronchial stage and acquire a size sufficient to cast a shadow on the roentgenogram. Typically, this type of new growth occurs near the hilus and extends toward the periphery of the lung-field. It may assume the character of the so-called infiltrative type with fringy, irregular borders that appear to give off ramifications in all directions,

THE DIAGNOSIS OF PRIMARY CARCINOMA OF THE LUNG¹

By C H HEACOCK, M D , and J CASH KING, M D , *Memphis, Tenn*

A VOLUMINOUS literature has accumulated regarding primary carcinoma of the lung. A great deal concerns the increased incidence of the disease, a relatively small amount concerns the diagnosis and treatment. However, many excellent articles have appeared regarding the diagnosis, the improved surgical procedures, and roentgen-ray therapy in malignant diseases of the chest. The American Society of Thoracic Surgeons has established a registry for lung tumors, which has stimulated interest and made possible more definite diagnoses based upon pathologic studies. It has only been since a large number of cases have been subjected to roentgen-ray and bronchoscopic examinations that the advance in accuracy of diagnosis has been appreciable.

Junghanns (8) gives an interesting table of clinical diagnoses based on 152 cases of carcinoma of the lung. They were tabulated according to five-year periods, from 1908 to 1929. In the early cases of this series, 10 per cent had a positive clinical diagnosis, whereas in the last group 48 per cent of the clinical diagnoses were correct. Since the greater progress was made between 1908 and 1929 in the special methods of examination, as roentgenologic and bronchoscopic, it seems reasonable to conclude that these agencies were responsible for the increased accuracy in diagnosis. Little has been contributed to the symptomatology and ordinary methods of physical examination during that time.

As a rule, the history is not a dependable guide. The onset of symptoms may be abrupt or gradual, coughing and expectoration may indicate merely bronchial irritation. In carcinoma, pain usually occurs early and is severe. Dyspnea is always present, and hemoptysis is fairly

common. The physical signs also are varied, but often the entrance of air into one or more lobes is limited. Probably the most important fact of all to remember is that the signs occur on only one side. The routine laboratory procedures, as blood studies, urinalyses, and sputum examinations, are seldom of value. When pleural effusion is present, a study of the aspirated fluid may give additional information. Blood-stained fluid, found in about half the cases, is suggestive.

Of the two methods of special examination, the bronchoscopic has definite advantages over the roentgenologic. It permits direct visualization of about 85 per cent of all the lesions—those occurring in the primary and secondary bronchi. Further, the operator may secure a biopsy specimen for histologic study. In early cases, as has been reported by Jackson (7), complete removal may be effected at the time the diagnostic study is made. The high degree of operative skill necessary for this procedure constitutes the chief limitation to its use. Highly skilled bronchoscopists are found in a few of the larger medical centers only, and probably those who can safely and successfully explore the tertiary bronchi are found only in a small number of world-famed clinics. It seems true to us that in the smaller cities the plane of radiology is higher than that of bronchoscopy. Because of their availability, roentgenologists see these patients first, and they must be able to recognize the possibility of a new-growth to determine whether or not many of them will ever reach a bronchoscopist. A large percentage of cases may be diagnosed from the roentgenograms alone, but many others will present findings which should suggest a bronchoscopic study.

Roentgenologic Diagnosis—Rist and Roland (12) observe six different radiologic appearances of carcinoma of the lung, Carman (2) followed Arnsperger, Jaugeas

¹ Presented before the Radiological Society of North America at Memphis, Tenn. Dec 3-7 1934.



Fig 4-A Case 4 (see table) Primary carcinoma of the right hilus with atelectasis and pleural effusion. Infiltrative type of metastasis of the left hilus. Case proven by autopsy.



Fig 4-B Same case as shown in Figure 4-A. Examination made six weeks later and after the aspiration of bloody fluid which permits the visualization of the tumor mass and the atelectasis.

of air, so that an atelectasis develops. In such cases we have an alternating emphysema and atelectasis—one of our patients demonstrated this phenomenon. All cases eventually manifest a stop-valve effect, with resulting atelectasis. After a lapse of a variable period of time, drowned lung follows, the defensive powers of the lung are destroyed, and the ventilation and drainage are cut off. Since organisms are always present, infection quickly develops, and we have, successively, bronchiectasis and abscess formation, and frequently gangrene. At this late stage the growth can no longer be recognized as a bronchogenic carcinoma. Even before we see all the manifestations of infection, however, pleural irritation may give rise to an effusion which will completely overshadow the original tumor.

Pulmonary newgrowths arising in the parenchyma of the lung, probably do not represent more than 15 per cent of all malignant primary growths. In Kirklin's series, however, there were 23 bronchogenic and 22 parenchymal types. The

parenchymal type starts as a nodule, which gradually increases in size until it involves the entire lobe. Its density is always more or less homogeneous, and its distinctive feature is its confinement by the interlobar pleura. The margins may be fringy or fairly circumscribed. When the right upper lobe is involved, the lower border of the density assumes an S-shaped curve, as Sante (13) has pointed out. Bronchial obstruction is not so likely to complicate the picture of a parenchymal tumor, but central necrosis may occur and produce a so-called cavernous carcinoma, described by Kerley (9). The squamous-cell carcinomas are parenchymal. Of 93 cases studied at autopsy by Atkins (1), those with definite cavitation were of the squamous-cell type. By direct extension to the pleura, these tumors may also cause pleural effusion.

The abstracts of 25 case histories are tabulated. In 13 of these, the diagnosis was based upon a pathologic foundation. Seven of the 13 patients came to autopsy, one had a surgical operation, and two had

especially toward the periphery of the lung field. On the contrary, the borders may be circumscribed with fair sharpness

causing either an obstructive atelectasis or an obstructive emphysema. In cases of stop-valve obstruction, the air distal to



Fig 3 Case 19 (see table) Circumscribed type of bronchial carcinoma. The borders of the tumor could not be determined until a film was made with the Bucky diaphragm with sufficient density to differentiate between the tumor and the atelectasis.

Since these growths are both intraluminal and extraluminal, it is necessary to understand the mechanism of bronchial obstruction. This has been well described by Jackson, who recognizes the following three mechanical types: first, stop-valve obstruction, in which no air can get in or out; second, by-pass valve obstruction, in which the lumen is simply narrowed; and third, check-valve obstruction, permitting the flow of air in one direction only, and

the obstruction is soon absorbed and we have an atelectasis of the lung supplied by that bronchus. By-pass valve obstruction is rarely encountered, as these growths so soon pass into the stage of stop-valve obstruction. In the early stages, malignant growths may produce a check-valve effect. At one time the growth may function so as to permit the entrance of air, causing an obstructive emphysema; at another time, it may prevent the entrance

Case	Symptoms	Physical signs	X ray findings	Pathologic report	Remarks
No 7 Male 46 yrs (21191)	History of cough and dyspnea of three months duration	Emaciation Signs of consolidation of right upper lobe	Consolidation of entire right upper lobe Homogeneous density Lower border has S' curve	Autopsy revealed cancer of lung Tumor mass involving entire right upper lobe Central area of necrosis Metastases to right lower lobes, liver and kidney	
No 8 F 46 yrs (21192)	Onset two weeks previously with cough and dyspnea Weight loss marked during stay in hospital	Dullness over right lobe from third to sixth ribs anteriorly Breath sounds decreasing over same area Sputum negative for tubercle bacilli No lesions seen on bronchoscopy	Nov 30 1932—hydropneumothorax on right side Jan 30 1933—small hydropneumothorax persists Entire lung consolidated with variations in density suggesting multiple small abscesses Left lung clear	Surgical diagnosis improper able cancer of lung	Died There was never any involvement of the other lung
No 9 Male 46 yrs (1971)	Productive cough for several months Loss of weight No hemoptysis	Clubbed fingers for eight months Emaciated No evidence of tumor in the bronchus	Circumscribed area of increased density (6 X 6 cm) anteriorly at left costophrenic angle Diaphragm adherent to mass Lipiodol injection shows abrupt termination of bronchus at borders of tumor	Metastatic mass removed from posterior thigh and femur reported adenocarcinoma	X ray treatment gave relief from pain but no regression in size of tumor On July 3 1934 bronchoscopy was negative Patient increasingly weaker Edema of feet and legs
No 10 Male 46 yrs (21915)	Dyspnea 4 plus with pain cough hemoptysis Duration six weeks	No loss of weight Right chest flat Right base flat Supraclavicular glands enlarged	Shadow occupying right apex above second interspace Solid tumor fluid in right side to third interspace Small amount of fluid in right base	Gland from right supraclavicular region showed metastatic carcinoma	Twelve hundred cc of clear fluid aspirated from right side
No 11 Male 46 yrs (10305)	Onset six weeks previously Pain in chest Loss of weight and strength Cough and jaundice	Dilated veins on right side of neck	April 12, 1934—shadow with fringing margins extending out from right hilus New growth	Bronchoscopy done with diagnosis of primary carcinoma No biopsy	One course of x ray treatment, no relief Died, June 9, 1934
No 12 R 46 yrs (10306)	Onset three months previously with cough dyspnea, and hemoptysis Also pain in right shoulder Loss of weight and strength	Emaciated Dullness in right apex Rales over same area	Dec 21 1926—complete consolidation of right upper lobe to level of seventh rib posteriorly Jan 31, 1927—dense shadow now reaches to level of eighth rib posteriorly Margins always sharply defined Trachea displaced to left March 24, 1927—entire right side now opaque Diagnosis primary carcinoma of lung	Bloody fluid aspirated from chest Cells reported malignant by pathologist (Dr Leake)	Discharged unimproved Died a few months later

Case	Symptoms	Physical signs	X ray findings	Pathologic report	Remarks
No 1 H W male, age 57 years	Onset with cough one year previously. Some loss of weight. Pain over left chest, with some dyspnea	Emaciated. Edema of both sides of neck. Decreased breath sounds over upper left lobe	On Jan 30 1933 there was an area of increased density on left side projecting from cardiac border. Margins very irregular. All peritrun cal shadows exaggerated	Gland removed from side of neck showed malignancy. Autopsy revealed a primary carcinoma of left lower bronchus. Metastases to cervical and mediastinal glands	Extreme emaciation and rapid death
No 2 H B male, age 72 years	Onset five weeks previously with repeated hemoptysis. Pain in left costal region of two months duration. No dyspnea. Some loss of weight and anorexia	Emaciated. Sticky rales at angle of left scapula	On Feb 10 1932 fluoroscopy and stereoencephograms revealed a small area of consolidation posterior to heart the size of a small orange. Diagnosis based on x ray and history was primary carcinoma of the lung	Died on Aug 20 1932. Autopsy revealed primary carcinoma of left lower lobe with metastases to both lungs hilar lobes and brain	No bronchoscopy. Diagnosis was made early from fluoroscopy
No 3 W I male, age 51 years	Onset six months previously with cough and blood streaked sputum. Lost 25 pounds weight in six months. Fever and sweats of two months duration. Slight increasing dyspnea	Emaciated. Dullness in right apex. Decreased expansion. Bronchovesicular breathing and rales in same area. Sputum negative for tubercle bacilli	On Jan 2 1930 there was an opacity of entire right upper lobe with an area of decreased density near the hilus. Reported as an abscess	Died a few months later. Autopsy showed a carcinoma of right upper lobe with abscess and gangrene	Patient improved after x ray therapy
No 4 Male, age 28 years (182)	Cough and pain in right chest for three months. Expectoration with no blood. Fever on one occasion	Dullness in right apex. Flatness at right base	Sept 8 1932—primary carcinoma of right hilus. Atelectasis of right middle and lower lobes. Infiltrative metastases of left lung. Oct 17 1934—opaque mass in the right hilus. Atelectasis of right middle and portion of right lower lobes. Metastases were extended	Died a few months later. Autopsy showed a carcinoma of right primary bronchus metastatic to left lung	Bloody fluid was aspirated (180 cc)
No 5 Female, age 62 years (218)	Cough dyspnea and pleuritic pain in left side	No record	(1) Uniform, dense circumscribed shadow of left hilus (2) Shadow increasing in size some distal atelectasis	Carcinoma of left upper bronchus extending into lobe and blocking bronchus. Areas of necrosis. Metastasis to right lung and to cervical glands	
No 6 Male, age 49 years (2117)	Duration two years. 50 pounds loss of weight. Severe cough and dyspnea. Hemoptysis	Emaciation. Signs of consolidation of upper right lobe	March 17 1931—shadow in right upper hilus not circumscribed. Trachea pulled over. March 21 1931—now atelectasis almost entire right lung	Autopsy revealed a mass (primary carcinoma) obstructing right upper bronchus. Atelectasis of right upper and middle lobes. Bronchiectasis. Metastases to liver kidney and thyroid	

Case	Symptoms	Physical signs	X-ray findings	Remarks and subsequent course
No 10 G L H male age 52 years	Onset ten months previously with cough and weakness. For part of two months has had hemoptysis. Some dyspnea	Râles over left upper lobe Marked emaciation	Aug 26 1933—opacity of entire left upper lobe with a circumscribed shadow of a mass (4×3 cm.) in left upper hilus. Heart and mediastinum displaced to left and left diaphragm elevated. Right lung and left lower lobe clear	Tumefaction held in check by x ray but general condition of patient very poor
No 20 Male, age 61 years (1871)	Onset 17 months earlier. Pleurisy with effusion. Cough, dyspnea, and pain in chest. Fifteen pounds loss in weight. Bloody expectoration, hoarseness	Dullness in right lower lobe Increased fremitus No fever	Mass in right costophrenic angle arising from hilus. Primary tumor	Wassermann negative x ray examination Patient died shortly after
No 21 Male, age 67 years (28377)	Onset six months previously. Pain in right shoulder and arm. Cough and expectoration. Dyspnea	No loss of weight Clubbing of fingers Dullness in right upper lobe	Tumor mass in right upper lobe. Primary carcinoma, with several small nodular metastases	Wassermann negative Died three months later No Horner's syndrome
No 22 Female, age 63 years (33010)	Onset, six months earlier. Dyspnea, pain in right shoulder, and cough. No hemoptysis	Lost 13 pounds in weight Dullness in right chest	Tumor filling posterior upper two-thirds of right chest. Fluid in right base. Opinion primary carcinoma	Numerous aspirations of clear fluid. Five courses of x ray treatment. Gradual regression of tumor and less secretion of fluid. After three years, the chest shows a retracted atelectasis of right upper lobe, with mediastinum drawn over and some diaphragmatic adhesions. No x ray treatment for two years, but patient free from symptoms
No 23 Female, age 52 years (30670)	Chest pains, cough and dyspnea for one month. Slight fever. Lost 12 pounds in six months	Dullness on right side No palpable glands	Aug 15, 1930—effusion, right side, probable tuberculosis. Nov 7, 1930—after aspiration, tumor mass in mid lung field on right	Died a few hours after aspiration of bloody fluid. No autopsy
No 24 Female, age 67 years (32781)	Symptoms of six months' duration. Pain and dyspnea, no hemoptysis. Lost 60 pounds. No fever	Dullness in right upper lobe, and râles all over	Oct 13 1932—right upper lobe airless. Tumor mass at right upper hilus. Metastases throughout the other lobes	No symptoms referable to other organs than lung. White blood count 12 850. Normal differential count. Died Oct 19 1932
No 25 Male, age 71 years (3190)	Symptoms of five months' duration. Cough outstanding symptom. No pain except on coughing. Yellow sputum	Dullness over large ovoid mass in right anterior chest	Opacity of entire right side. No displacement of heart or mediastinum	Lived about two months after discharge. Mass ulcerated chest wall before death

Case	Symptoms	Physical signs	X-ray findings	Pathologic report	Remarks
No 13 Male age 52 years (31725)	Sick for only six weeks Began as a cold, Cough dyspnea expectoration pain and fever	Dullness right side En- largement of veins of neck Blotchy rash	Consolidation of right upper and middle lobes Fluid at right base Infiltrative me- tastasis to left side	Bloody fluid aspirated and studied by Dr J A Mc Intosh, who regarded it as an exudate of malignancy	Died two months after discharge
No 14 M S male age 54 years	Loss of weight was gradual Onset with cough ten months earlier No hemoptysis Anorexia previous two weeks Diarrhea with 10 to 12 stools per day	Emaciated, no other physical findings	Oct 8 1934—sharply cir- cumscribed area of increased density of right upper lobe 10 X 7 cm Primary car- cinoma Castro intestinal tract negative	Patient very weak dehydrated study negative except for purulent secretion from right bronchus Tumor held in check by \ ray therapy but patient grew progressively weak and emaciated and recently died	Remarks and subsequent course Bronchoscopic Bronchoscopic
No 15 Male, age 50 years (35056)	Duration, eight months Cough fever, exhaustion dyspnea, and hoarseness	Lost ten pounds weight No râles Harsh breath sounds on right side	Large shadow in right hilus with infiltrative borders No atelectasis Carcinoma of right bronchus	Bronchoscopy done not satisfactory Tissue re- moved reported as chronic inflammatory No changes after two courses of \ ray treatment Pa- tient was found dead in bed five months after first visit Massive bronchial hemorrhage	
No 16 G R male, age 60 years	Onset nine months previ- ously Cough, with thick white sputum Pain in left chest Profuse sweats for two weeks	Emaciated Tenderness on pressure over left iliac bone and hip Resonance im- paired over both apices Numerous râles	June 25 1920—irregular area of increased density of right upper hilus Atelectasis of lower portion of right upper lobe Slight elevation of right diaphragm July 24 1920—complete opac- ity of right chest Probably both atelectasis and fluid No displacement Opinion carcinoma of right hilus	Died Sept 20 1920 No autopsy	
No 17 A H W male age 60 years	No cough or hemoptysis Pain in lumbar region and left chest with slight dyspnea on exertion	Fairly well developed Limited motion of right chest with dullness Voice sounds distant over same area	Nov 10, 1932—entire right chest filled with fluid Nov 22 1932—same Nov 28 1932—after aspira- tion right middle lobe shows a rounded circumscribed mass (tumor) Dec 2 1932—same	Chest fluid showed round cells with foamy cyto- plasm Discharged unimproved Nausea vomit- ing and restlessness Died	
No 18 J W male age 39 years	Onset three months previ- ously with hemoptysis and pain beneath right shoulder and axilla Marked loss of weight	Emaciated Decreased ex- pansion on right Dullness in right apex about two inches in diameter Diminished breath sounds Increased voice sounds	Nov 24 1931—atelectasis of right upper and middle lobes with tumefaction of center right upper lobe Elevation right diaphragm Dec 13 1931—re-expansion of middle and lower lobes Tumor mass more definite in upper lobe	Aspirated chest fluid bloody Numerous courses of \ ray treatment brought about improvement tem- porarily but patient subsequently died	

two considerable time elapsed between the roentgen-ray examination and the necropsy

Differential Diagnosis—In the last stages, the pathologic evidence is so massive that primary carcinoma of the bronchus may be mistaken for almost any extensive infection. From the history and physical signs it may be easily confused with tuberculosis, yet it is not likely to be confused roentgenologically unless we have a tuberculous pneumonia involving the entire lobe.

In our series of cases, lung abscesses proved the most difficult from the point of view of differential diagnosis. When near the hilus they resemble a bronchogenic carcinoma, with its radiating, strand-like infiltrated border. When in the central part of the lobe, the abscesses may appear to be of the parenchymal type. A study of our films did not reveal any points of differentiation, and at times even the clinical history was not conclusive.

Benign tumors, as adenomas and fibromas, cast solitary shadows with sharply circumscribed borders. These are more likely to be mistaken for metastatic tumors than for primary carcinomas.

The differential diagnosis between aneurysms and primary carcinomas of the lung is at times difficult. This was true in one of our recent cases. The patient was a male, 43 years of age, who came into the hospital because of persistent chest pains, dyspnea, cough, and repeated small hemoptyses. Physical examination revealed a sub-febrile temperature, and signs of massive consolidation of the left lung. The usual physical signs of aneurysm were absent. The Wassermann test was positive. There were no tubercle bacilli in the sputum. Roentgen-ray examination showed a consolidation of almost the entire left lung except the apex and costophrenic angle. The trachea and the mediastinal structures were displaced toward the affected side and the left diaphragm was paralyzed. The roentgenologic diagnosis was primary carcinoma with atelectasis. A bronchoscopic examination was reported

unsatisfactory and the conclusions indeterminate. At necropsy, a large saccular aneurysm was found arising from the descending aorta. It had completely obliterated the left pulmonary vein and the left primary bronchus, and had eroded the bodies of the third and fourth thoracic vertebrae. That this case was not an exceptional one is illustrated by the reports in the literature. Clerc (3) reports two cases, Deschamps and Mourrut (4) report one, and Deschamps and Schwab (5), one. In three of these, all of which came to necropsy, the diagnoses were so certain from a clinical point of view that radiation therapy was given.

Another case which was diagnosed as primary carcinoma of the lung proved at autopsy to be an endothelioma of the pleura. Roentgenograms showed a complete consolidation of the entire right lung except for the apex and costophrenic angle. There were metastases in the opposite lung, but the radiographs showed no evidence of the displacement of the heart or mediastinum.

Technic—It is our practice to make stereoroentgenograms in every case of suspected neoplasm of the lung, but we are convinced that if stereoroentgenograms are relied upon solely, many will not be discovered. Figure 1 illustrates the findings in the first examination of a patient who later developed a consolidation of the entire left lower lobe, and at autopsy was found to have a primary carcinoma. A postero-anterior view of the chest showed a few changes at the left cardio-phrenic angle, but fluoroscopy in the oblique view revealed an irregular area of increased density behind the cardiac shadow, and furnished the only clue that led to the correct diagnosis. In addition to the fluoroscopic examination, films made in the lateral position are generally regarded as indispensable. We have been impressed by the value of a film, made on the Bucky diaphragm, with sufficient density to make possible a differentiation of the conglomerate shadows which make up an opacity in the lung-field.

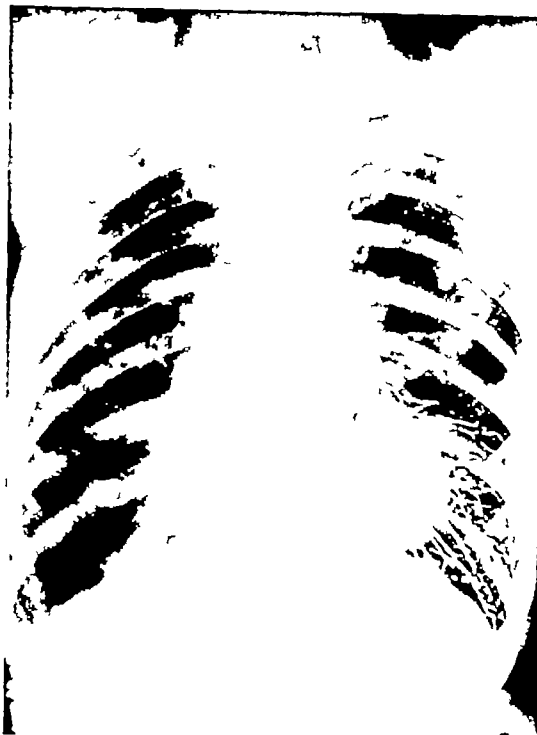


Fig 5-A Case 9 (see table) Lipiodol injection shows that the tumor does not involve the primary bronchi. The distal bronchi terminate abruptly at the borders of the tumor.



Fig 5-B Same case as shown in Figure 5-A. Lateral view shows that the bronchi which extend beyond the tumor are posterior to it.

biopsy examinations of metastatic deposits. The pathologist was able to find malignant cells in the aspirated fluid from two patients, the thirteenth was diagnosed by the bronchoscopist. In ten of these 13 cases, the diagnoses were made definitely or the possibility of primary carcinoma pointed out by the roentgenologist. Of the remaining three, one was mistaken for pneumonia, one was reported as an abscess, and one as multiple abscesses. The latter two interpretations were correct, but it was not recognized that the abscesses were complications. In the other 12, there was complete accord in the opinion of the clinicians and roentgenologists regarding the diagnoses. The symptoms, roentgenologic appearance, and subsequent history all combined to eliminate any doubt.

A statistical study shows that this group conforms to nearly all those previously studied. There were 20 males and 5 fe-

males, the oldest was 72 and the youngest 28, the average age being 55. Twenty of the tumors were on the right side and five on the left. Classification according to the grouping of Kirklin and Paterson is as follows:

Bronchial	14
Parenchymal	6
Late	5

Fluid was present in only nine patients and was sanguinous in five. It was difficult at times to decide whether a consolidation was all tumor or tumor with atelectasis. The films were carefully reviewed, however, and in 13 of the 25 patients we believe atelectasis was present. Bronchiectasis was never diagnosed roentgenologically, but was found once by the pathologist at necropsy. Four patients were known to have had abscesses, although these were apparent in the roentgenograms in only two of the four cases. In the other

A ROENTGEN CONSIDERATION OF MEDIASTINAL TUMORS¹

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THE management of intrathoracic disease is peculiarly the responsibility of the roentgenologist for his is the method of accurate detection, differential diagnosis, indication and guide in therapy, and in certain conditions his may be the healing agent necessary for the optimum result. This applies especially to intrathoracic and more particularly to mediastinal neoplasms, conditions which were rarely recognized in the pre-roentgen period and, if recognized, could not be successfully treated by methods known at that time.

The study of mediastinal tumors, as to their early recognition and accurate classification, should receive our earnest consideration, patients suffering from these lesions may be benefited either by their surgical removal or control, and, in some instances, their eradication by roentgen therapy.

Incidence—It is agreed by all observers that the number of reported cases of mediastinal tumors has increased rapidly during the past decade or two, but there is no agreement that this represents an actual increase in the incidence of the disease. Just as fracture statistics and those of many other medical problems have undergone marked revision under the influence of roentgen knowledge, so figures dealing with neoplastic disease as a whole bear careful analysis. We must all recognize that lessened infant and childhood mortality has increased the span of life, so that the average is advanced more than one-third, and that under these conditions, tumors and degenerative diseases are to be encountered more frequently.

To facilitate the presentation of the particular division of intrathoracic tumors assigned to us in this symposium, we have

elected to review briefly the essential features of our own series of cases examined and treated at the Harper Hospital. During the period from 1922 to the present time, we have examined 60 cases of all types of mediastinal neoplasms. They represent less than 1 per cent of all the neoplasms coming under our observation during this period, a fact which indicates their relative infrequency.

Mediastinal tumors should be identified and classified according to history, clinical investigation, roentgen examination and, in some cases, microscopic examination of tissue removed for biopsy.

Pathologic Considerations—Mediastinal tumors are either primary or secondary. Primary tumors may originate in the lymph nodes, connective tissue, thymic or thyroid gland, and in the blood vessels of the mediastinum. The classification of the primary tumor is usually more difficult than of the secondary as the latter is of the same nature as the mother tumor, which can usually be identified by biopsy. Mediastinal tumors as a whole may be further classified as benign and malignant. In the benign group are placed the following:

- 1 Cysts (echinococcus, dermoid, etc.),
- 2 Ganglionic neuroma,
- 3 Fibroma,
- 4 Chondroma,
- 5 Lipoma,
- 6 Aneurysm

A classification of malignant mediastinal tumors is more difficult for the reason that pathologists vary in opinion as to the histogenic nature of many of these neoplasms, but, for practical purposes, the following grouping has been found satisfactory:

- 1 Lymphoma (lymphosarcoma, pseudoleukemia, aleukemic leukemia, lymphatic leukemia, malignant granuloma or Hodgkin's disease, and thymoma),

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In addition to these relatively simple technical procedures, it is at times advisable to continue the roentgenologic study after certain special procedures have been carried out. These special procedures may include the aspiration of fluid, the production of an artificial pneumothorax, or the injection of an opaque oil into the bronchial tree. It is rather doubtful if artificial pneumothorax or bronchography should be resorted to if a skillful bronchoscopist is available. Unless the bronchoscopic examination is performed skillfully, we believe more information may be obtained by employing the radiographic and fluoroscopic methods that have just been outlined. Even though the roentgenogram may not lead to a positive diagnosis of primary carcinoma of the lung, it is more valuable than any other measure in determining the location and extent of the pathologic condition.

SUMMARY

1 Twenty-five fairly definitely proven cases are reported. In 13 of these there is some pathologic confirmation of the diagnosis.

2 Until every city is provided with a skilled bronchoscopist, the burden of recognizing primary carcinoma of the lung will rest on the shoulders of the roentgenologists.

3 While there is no pathognomonic roentgenologic appearance, there is a picture which, when present on only one side,

should always suggest a primary new-growth to the radiologist. It should then be regarded as malignant until proven otherwise.

4 Biopsy material removed by the surgeon or bronchoscopist to-day offers the most reliable method of making this differentiation.

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of an aneurysm, as a few cases of neoplasm have exhibited it, and at times even with most careful study the presence or absence of pulsation cannot be detected in the fluoroscopic image. Of the accessory methods, the administration of barium mixture is an aid in demonstrating the relationship with the esophagus, especially the degree of encroachment upon its lumen. On the other hand, the intratracheal instillation of lipiodol often permits the visualization of the degree of encroachment on the pulmonary tissues. In certain instances, especially those cases complicated by pleural effusion, induced pneumothorax proves of distinct advantage.

Therapeutic Test Dose as a Method of Differentiation—For the last ten years, an increasing effort has been made to utilize the variation in the radiosensitivity of mediastinal tumors as a guide in their differential classification. This method consists of the administration of the largest irradiation dose over the tumor area which can be tolerated without injury to the normal tissue (as a rule, 110 to 130 per cent *s u d*). The variation in the response of tumors is then estimated and used as an index of their differentiation. It is a well known fact that the degree of radiosensitivity of the neoplastic tissues is governed in a general way by the cellular characteristics of the neoplasm. From the response to radiation, certain conclusions may be formed concerning the morphologic nature of the tumors irradiated.

The neoplasms of the mediastinum are composed of cellular elements which, in the scale of radiosensitivity, show the greatest variation. Some of them disappear very rapidly following irradiation, others remain refractory, and still others disappear slowly. By making use of this behavior phenomenon, we may place all mediastinal tumors in several groups.

Group 1—Tumors arising from the lymphocytic cell element, such as lymphosarcomas, thymomas, pseudoleukemias, and lymphatic leukemias, which will entirely disappear within from four to ten

days following the administration of a therapeutic test dose.

Group 2—Tumors originating from the reticulo-endothelial cells of the mediastinal lymph glands and the thymus, such as Hodgkin's disease, Sternberg type of hyperplastic tuberculosis, and endothelioma. These tumors respond more slowly, being reduced within ten days following the administration of a therapeutic test dose to one-half their original size, and disappearing entirely in about six weeks or longer following the treatment.

Group 3—Other primary mediastinal tumors, which have their origin from the areolar tissue (such as fibrosarcoma, large round-cell sarcoma), are carcinoma of the thymus and thyroid glands, and teratomas. These tumors show some reduction in size following exposure, but rarely disappear at the end of six weeks. They may be said to have a rather low degree of radiosensitivity, having a latent period of growth and then showing evidence of uncontrolled increase in size.

Group 4—Benign tumors of the mediastinum (lipoma, chondroma, fibroma, neuroma, dermoid) or pseudo-tumors (aneurysms, mediastinal abscess, mediastinal effusion), with the exception of fibroma, are not influenced by radiation. Fibromas probably do respond—but very slowly—and in this respect they manifest the same response as is observed in uterine fibroids.

While it is recognized that the sharp differentiation and the assignment to the above groups may in some cases form a source of error, nevertheless, it is felt that in practice the method is of sufficient value to recommend its use.

A review of our cases shows that 48 per cent fall into Groups 1 and 2, indicating that they represent lymphosarcoma and Hodgkin's disease, and since grouping by the therapeutic test dose is of great value in this instance, we may conclude that a rather large group may be safely classified as a result of its use. On the other hand, the benign tumors, perhaps with the exception of fibromas, will show no response to the application of the therapeutic test

2 Sarcoma, as a rule, originating from areolar connective tissue (fibrosarcoma, spindle-cell sarcoma, and alveolar cell sarcoma),

3 Carcinoma of thymic and thyroid origin,

4 Teratoma

Clinical Symptomatology—The essential clinical features of these tumors are well known and have been thoroughly discussed in medical literature, so that a detailed consideration need not form a part of this presentation. We wish, however, to call attention to a few of the less common symptoms which have been observed by us. The secondary effects of very large tumors, in addition to the symptoms of respiratory embarrassment, may produce marked edema of the neck and face, in one of our cases a pronounced conjunctivitis was one of the outstanding findings and accompanied the edema. Mention is made of these unusual features as they enter into the technic of roentgen therapy. In several of our cases, the edema and respiratory difficulties were of such severity that treatment could be given only while the patient was being sustained by the administration of oxygen. Since heavy radiation treatment may increase the edema and respiratory difficulty, it sometimes appears advisable to resort to the fractional method of treatment with smaller doses in cases in which the indications for such a procedure exist.

Hemorrhage is to be mentioned as a relatively rare but important complication. In one of our cases there were several hemorrhages which, together with the roentgen manifestations, pointed to a pulmonary rather than to a mediastinal tumor. However, at autopsy, it was found that the tumor was primarily in the mediastinum, the hemorrhage having occurred as the result of a ruptured blood vessel caused by pressure from the tumor. The conclusion is that hemorrhage does not indicate that the neoplasm has its origin in the pulmonary tissues.

While the importance of a history and a careful clinical investigation is recognized,

the value of a complete roentgenologic examination cannot be over-emphasized. Adequate co-operation between the clinician and roentgenologist is of utmost importance.

Roentgen Findings—Roentgen procedures have increased in number and scope due to technical development and the introduction of associated forms of investigation. However, a careful fluoroscopic and roentgenographic study of the suspect is still a dominating procedure. We need not emphasize the necessity of adequate ocular accommodation before fluoroscopy is attempted. Films should be made in all important positions, we feel that the study in the lateral position is most important.

By these procedures, in addition to the information regarding the size, shape, configuration, and location of tumors, secondary changes may be demonstrated which are the effect of pressure changes on surrounding structures. Outstanding among these are atelectasis of all or part of one or more lobes, and pleural effusion. Both of these may be so pronounced that they may entirely obscure the image of the primary lesion. Some observers are of the opinion that pleural effusion is an indication of pleural metastases, but in several cases we have observed it to be the result of pressure by the tumor against the vessels.

Some writers have drawn up certain criteria by which they attempt to establish an absolute differential diagnosis of the various types from the roentgen image alone. In our experience, shadow changes produced by some of the mediastinal tumors are not always constant, for instance, Hodgkin's disease does not always produce a shadow with sharply defined smooth borders. Not infrequently its edges are hazy and irregular, gradually blending with the shadows of adjacent pulmonary structures. We are further of the opinion that too much importance has at times been placed on the phenomenon of pulsation. In our experience, expansile pulsation is not always a safe index.

EXTRA-PULMONARY TUMORS OF THE THORAX¹

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THE extra-pulmonary and extra-mediastinal tumors of the thorax include a large variety of uncommon lesions, for the most part rare in the experience of the clinician, the roentgenologist, or the pathologist. For the purpose of this symposium an artificial relationship based on location has been imposed. In such an heterogeneous mixture, it has been difficult to deduce any semblance of reasonable relationship between the individual types of tumors. The following arrangement, by origin as well as location, may serve to orient the reader in some degree.

I Tumors of the thoracic wall proper

- (a) Non-malignant primary neoplasm,
- (b) Malignant primary neoplasm,
- (c) Metastatic malignant neoplasm,
- (d) Ganglionic neuroma and neurofibroma

II Tumors of the pleura

- (a) Extrinsic source,
 - (1) Metastatic malignancy,
 - (2) Hydatid,
 - (3) Tuberculoma,
 - (4) Fibrinoma
- (b) Intrinsic source,
 - (1) Endothelioma of pleura,
 - (2) Chondroma of pleura

III Tumors of other local origin

- (a) Aneurysm of the innominate artery,
- (b) Embryonal rests,

- (c) Primary carcinoma of the pulmonary apex (superior pulmonary sulcus tumor)

I—TUMORS OF THE THORACIC WALL PROPER

(a) The large group of non-malignant primary neoplasms of the thoracic wall includes the tumorous hyperplasias on any one or more of the mesodermal derivatives which are involved in the formation of the wall proper, such as lipoma, fibroma, myxoma, chondroma, osteochondroma, and angioma. As a group, these non-malignant thoracic wall tumors will present a prolonged history of known mass, and pain, dependent upon the degree of pressure on intercostal nerves or pleura. Dyspnea is present only if the tumor should attain sufficient size to embarrass the respiratory function. Pleural effusion is uncommon.

These masses may obscure the underlying pulmonary fields in a degree corresponding to their thickness and specific density. As a rule they will be found as rather sessile tumors, sharply margined, and homogeneous in character of shadow. Both fibroma and myxoma have been reported as presenting, both externally and internally, as a "collar-button mass," or as spreading the ribs apart by the intercostal tumefaction.

Chondroma, osteochondroma, and osteoma are rather familiar to the roentgenologist. They are most common in individuals who have multiple osteochondromas of the familial type. Roentgenographically, the last two present architectural characteristics which distinguish them definitely from the other connective tissue tumors. Similar comment applies to benign giant-cell tumor of the rib.

¹ Presented before the Radiological Society of North America at Memphis, Tenn. Dec. 3-7, 1934.

dose, and they may be separated on this basis. A differentiation of the latter group, from occasional refractory malignant neoplasms, is made from the fact that observation over longer periods following the treatment will show that very little progress in the growth has taken place, whereas the more refractory malignant neoplasms in the meantime would have continued to increase in size. Thus by considering all factors, one is able to segregate in practice the majority of the mediastinal neoplasms, the unclassified group shrinking down to something less than 30 per cent.

Application of the therapeutic test dose would by no means jeopardize surgical consideration where and when it is indicated. A review of the literature pertaining to surgical removal of mediastinal tumors shows that while some brilliant results have been obtained in the removal of benign neoplasms, nearly all cases suffering from malignant mediastinal tumors have died either as a result of extension or metastases in a few years. Thus, since it cannot be said that the application of a therapeutic test dose would produce a harmful delay in the malignant

cases, and if carried out with a non-injurious dose as regards normal tissues, in the benign cases a surgical intervention may always be undertaken at a later date without any greater risk.

It seems to us that the best procedure in the treatment of mediastinal tumors is first, in all instances, to apply radiation therapy in the form of a therapeutic test dose, and to reserve for surgery those cases which, as a result of the investigation, have been shown to be benign, or those in which the diagnosis in spite of all investigation remains doubtful.

CONCLUSIONS

In summarizing the entire subject, it becomes apparent that the use of roentgen rays, both from the diagnostic and therapeutic standpoints, plays a decisive rôle in dealing with intrathoracic and especially mediastinal tumors. A consideration of the clinical features may help to enlarge the field of knowledge, and surgical procedure may, in certain instances, prove more advantageous, but the application of roentgen methods will remain the most important.



Figs 2 A, 2 B, and 2 C Case II G. L. female aged 13 years (Courtesy of Dr. W. A. Irwin, Detroit, Michigan) Chondrosarcoma, arising from sixth rib. Fig 2 A Gross neoplasm obscuring the right pulmonary structures. Fig 2 B Study with Potter-Bucky diaphragm. Involvement of fifth and seventh ribs by pressure of primary tumor arising from the sixth rib. Fig 2-C Detail of surgical specimen removed.

common beneath the costal pleura, and may be fairly well encapsulated. Pleural effusion will vary in degree, roentgenologically it would be difficult to differentiate from a large non-malignant tumor or an unevacuated cyst.

The myxo-angio-endothelioma of Davison produced destruction of the neighboring ribs, with tumefaction, both extra- and intra-thoracic, but apparently without marked pleural effusion. It could not be distinguished roentgenographically from any other soft malignant neoplasm arising in the thoracic wall. From the roentgen appearance it might have been either a primary or metastatic malignancy of the thoracic wall.

(c) Metastatic malignant neoplasm of practically any origin may involve the thoracic wall. In our clinic the most common have been carcinoma of the breast, osteogenic sarcoma, lymphoblastoma, myeloblastoma, and Ewing's endothelioma of the bone. In general, these involve the ribs or sternum first, and by tumefaction and invasion displace the parietal pleura to obscure or compress the underlying lung.

Differential diagnosis of these within the

group from primary malignancy of the thoracic wall is rarely possible on roentgen study alone. The osteoblastic bone sarcomas may demonstrate as much new bone in the secondary as in the primary tumor. Careful clinical scrutiny of the patient must be made if no primary source is known.

Therapeutic test of high voltage irradiation will induce a reduction in size, at times a disappearance of metastatic carcinoma of the breast, lymphoblastoma (Case III, Figs 3-A, 3-B, 3-C, and 3-D), and Ewing's endothelioma of the bone. There will be some residual evidence of the neoplastic damage to the bone or pleura. The metastatic carcinoma of breast and lymphoblastoma will show the more rapid response. Myeloblastoma responds more slowly than the above three, is primarily expansile, and of medullary origin. Further, monosteous myeloblastoma is uncommon in the ribs. Osteogenic sarcoma is the least responsive in this group to irradiation. We have not seen metastatic hypernephroma of great size in the ribs.

(d) Ganglioneuroma and neurofibroma (neurinoma) comprise another group, rela-



Figs 1-A and 1-B Case I L G, No 323,608, female, aged 33 years Angioma of the thoracic wall with calcified phleboliths Fig 1-A Frontal view of entire thorax pneumothorax for pulmonary tuberculosis pleural irregularity left axilla Calcified phleboliths Fig 1-B Detail showing area of angioma of the thoracic wall

The angioid neoplasms present certain changes which may serve to distinguish them. Although the other tumors of this general group may produce palpable external masses, or local changes in percussion note, depending upon total depth of tumor or the degree of compression of the underlying lung, the angioid non-malignant tumor will present a slight thrill on palpation and auscultation. On the roentgenogram these will often show an occasional calculus similar to a phlebolith in its vascular channels (Case I, Figs 1-A and 1-B).

(b) The malignant primary tumors of the thoracic wall include chondrosarcoma, osteochondrosarcoma, and osteogenic sarcoma of the ribs, "giant sarcoma," myxangioma-endothelioma.

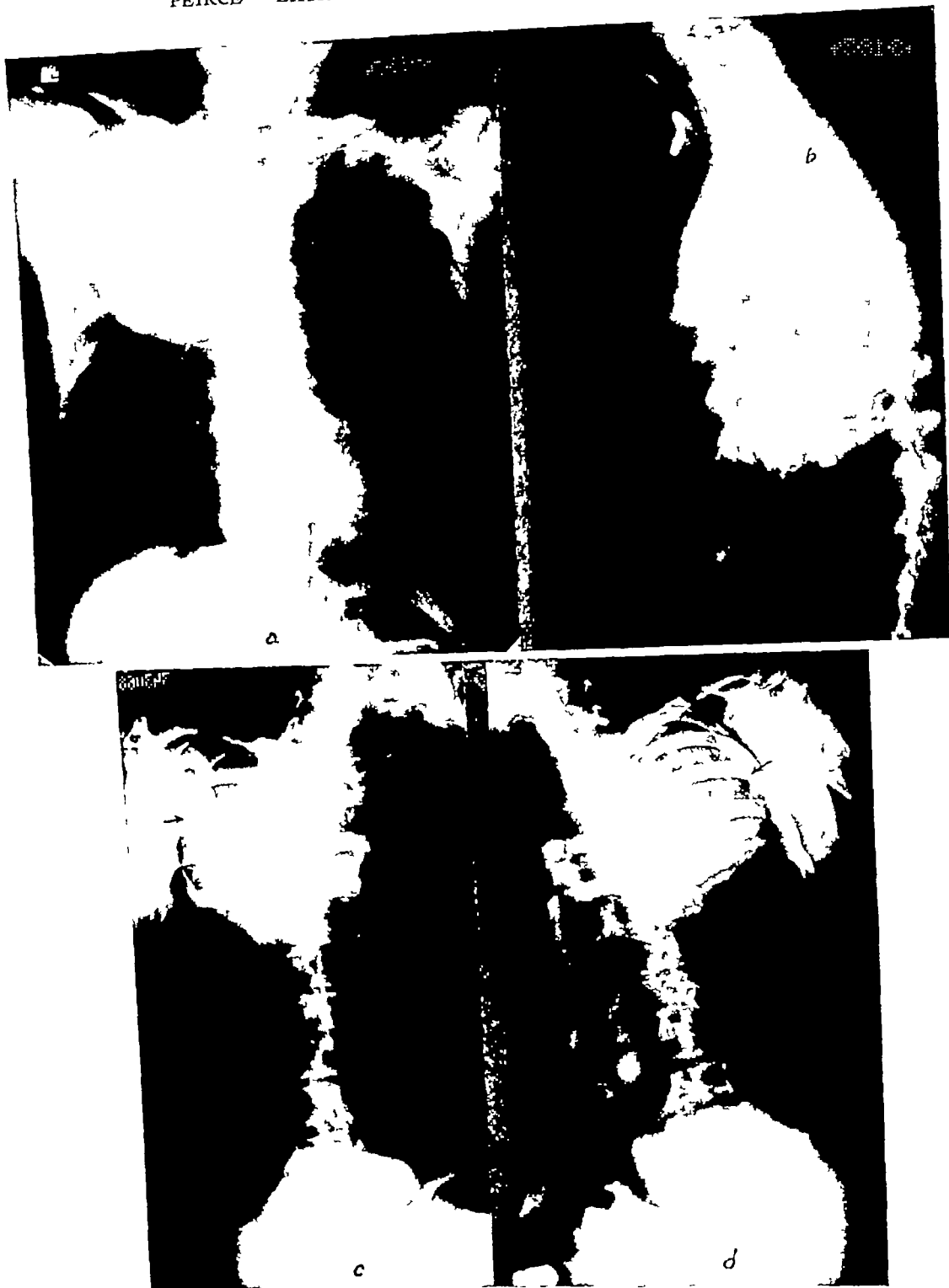
The first three of these, arising in or from the bone, cartilage, or periosteum of the ribs, are distinguished from the non-malignant group by the much shorter history, the destruction of the bony cage

locally, and by more severe pain and pleural effusion. They tend to progress rapidly and may or may not show evidence of new bone formation as is the character of the primary bone neoplasms (Case II, Figs 2-A, 2-B, and 2-C. Courtesy of Dr W. A. Irwin, of Detroit, Mich.).

In this group it is important to determine the presence or absence of visceroparietal pleural fixation over the tumor as an indication of the degree of pulmonary invasion.

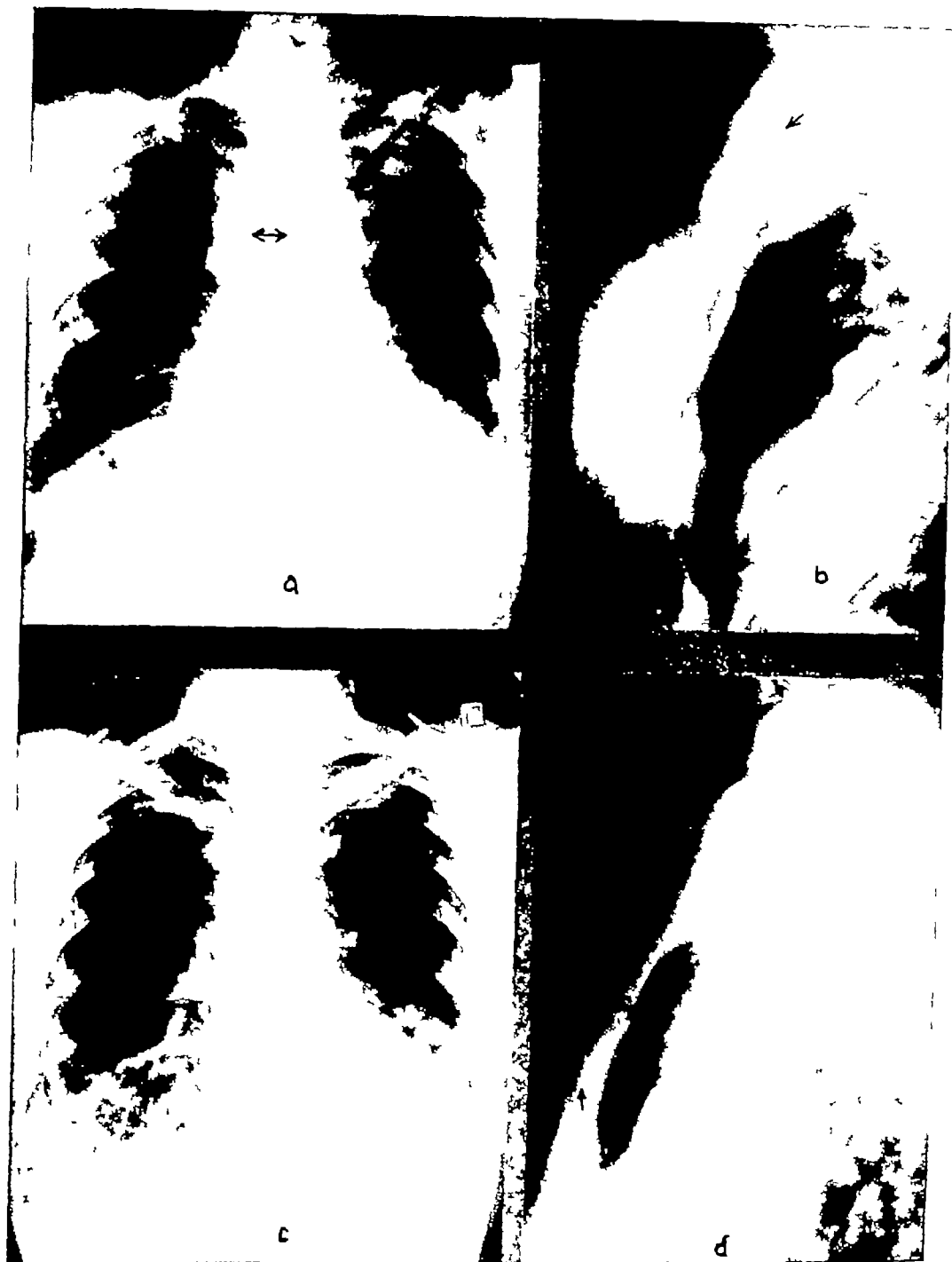
We have previously reported a spindle-cell osteogenic sarcoma arising in a giant-cell tumor of the rib, with neoplastic involvement of the pleura. In that patient a diagnostic or preparatory pneumothorax, with subsequent films, was of great assistance in the determination of the extent of involvement, as well as offering further information as to the nature of the tumor.

The giant sarcoma described by Lilienthal and Klemperer may attain gross size. It is a highly cellular fibrosarcoma, most



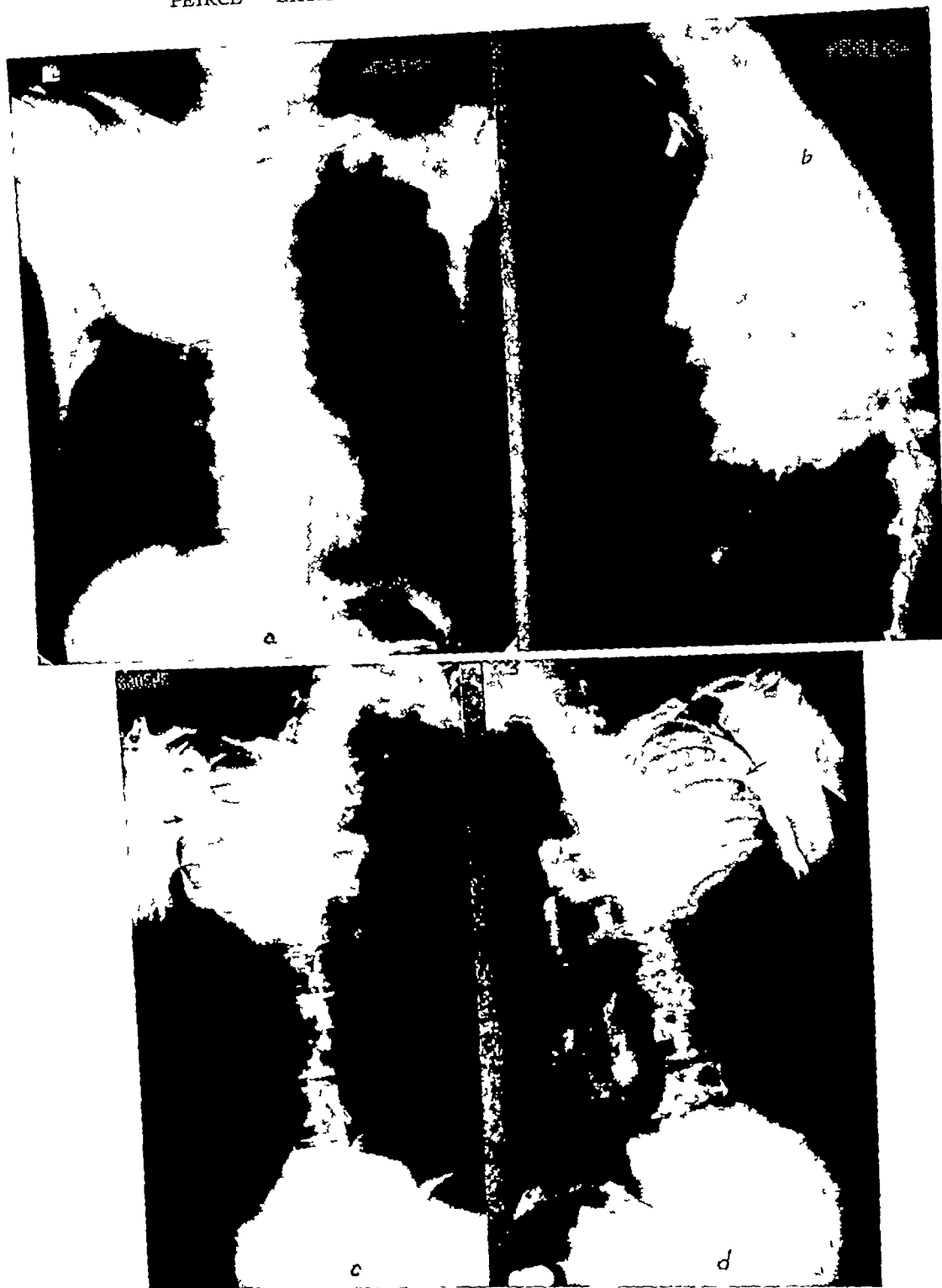
Figs 5 1 2 5 B and 5 C Case V H R, No 343 068 male aged 40 years Primary carcinoma of bronchus Gross metastases arising in the pleura right thorax compressing the lung Metastases to kidney and adrenals Fig 5 A Frontal view Fig 5 B Lateral some displacement of the esophagus Figs 5 C and 5 D Oblique projections Potter Bucky diaphragm following pre-operative pneumothorax, show a fixation of lung and pleura by tumor

* Case IV is not illustrated



Figs 3 A, 3 B 3 C and 3 D Case III F D No 332 531 female aged 24 years Lymphoblastoma involving sternum and lung Fig 3-A Frontal view pulmonary infiltration overlying tumor mass, widened sternal shadow Fig 3-B Lateral showing gross involvement of sternum Fig 3 C Frontal view after x radiation therapy Fig 3 D Lateral following irradiation Minimal residual defect in body of sternum

tively rare in the thorax Ganglioneuroma, arising in connection with the sympathetic system, will predominantly appear in the posterior, or paravertebral gutter, or the



Figs 5-A * 5-B and 5-C Case V H R, No 343 068 male, aged 40 years Primary carcinoma of bronchus Gross metastases arising in the pleura right thorax compressing the lung Metastases to kidney and adrenals Fig 5-A Frontal view Fig 5-B Lateral, some displacement of the esophagus Figs 5-C and 5-D Oblique projections Potter-Bucky diaphragm following pre-operative pneumothorax, show a fixation of lung and pleura by tumor

* Case IV is not illustrated



Figs 6-A and 6-B Case VI C F No 202 616 male aged 30 years Echinococcus cyst Fig 6-A Frontal plane, appearance had been confused with encapsulated empyema Fig 6-B Lateral demonstrating position of cyst in the interlobar fissure Subsequent surgical removal Excellent condition after three years

mediastinum In time, manifestations of disturbance of the sympathetics involved in the tumor may appear The roentgen character is usually that of a round or ovoid homogeneous tumor roentgen differentiation is difficult

Neurofibroma (von Recklinghausen) or neurinoma in the thorax most commonly is associated with the intercostal nerves Makkas has recently reported a survey of the published cases, with two neurinomas from his own series, a total of twenty-eight This neoplasm tends to be either sessile or nodular in the thoracic parietes, or globular when found in the posterior gutter or mediastinum In the parietal portion of the thorax it may present an appearance similar to neoplastic metastatic involvement of the pleura or a pleural endothelioma Simular tumors elsewhere in the body or the presence of a known primary neoplasm will assist in the differentiation

II—TUMORS OF THE PLEURA

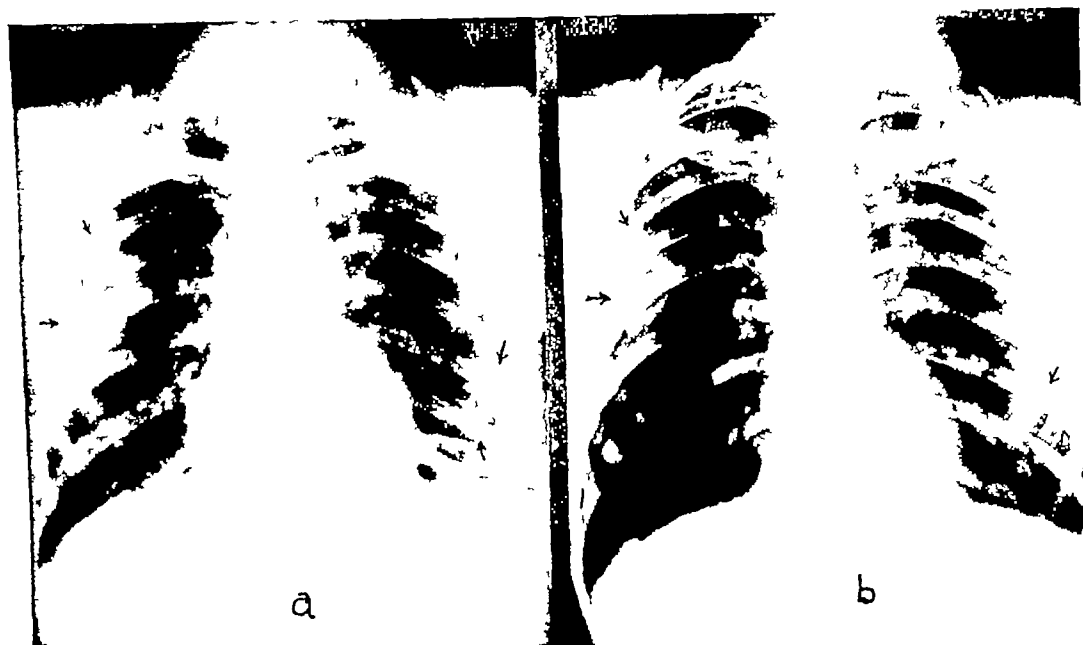
(a) The tumors involving the pleura of extrinsic origin include chiefly metastatic malignancy, echinococcus cyst, tuberculoma, and fibrinoma

(1) Metastatic malignancy may invade, or be implanted in, the parietal pleura Here again the problems of differentiation discussed above in regard to metastatic involvement of the thoracic wall appear Carcinoma of the breast (Case IV) and carcinoma of the bronchus (Case V, Figs 5-A, 5-B, and 5-C) have been the common offenders in our experience Both of these generally invade rather than become implanted

(2) The hydatid (echinococcus) cyst found in the thorax has been commonly a pulmonary implant or an extension through the diaphragm from the liver These masses are usually sharply circumscribed, and are said to present a flocculent deposition of calcium, especially in the cyst wall However, they may be quite homogeneous



Figs 7-A and 7-B Case VII H B, No 346 548, male, aged 55 years Hypernephroma, primitive type
Fig 7-A Pleural metastasis, left axilla Fig 7-B Hepatic mass with calcium deposition

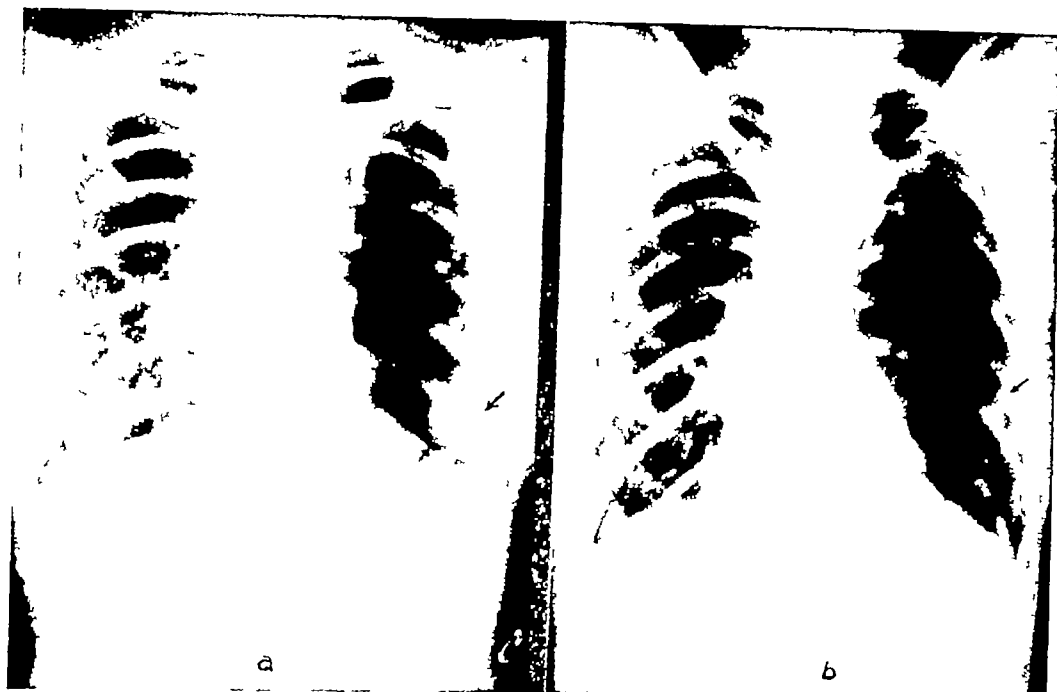


Figs 8-A and 8-B Case VIII E M, No 345 187, male aged 17 years Tuberculoma (miliary tuberculosis)
Fig 8-A Routine chest examination, circumscribed tumor mass containing some calcium Fig 8-B
Study with Potter Bucky diaphragm for contrast

in roentgen appearance If pleural rupture should occur, the subsequent reaction, both clinical and roentgenologic, may simu-

late severe empyema They are often clinically silent

In the past four years at the University



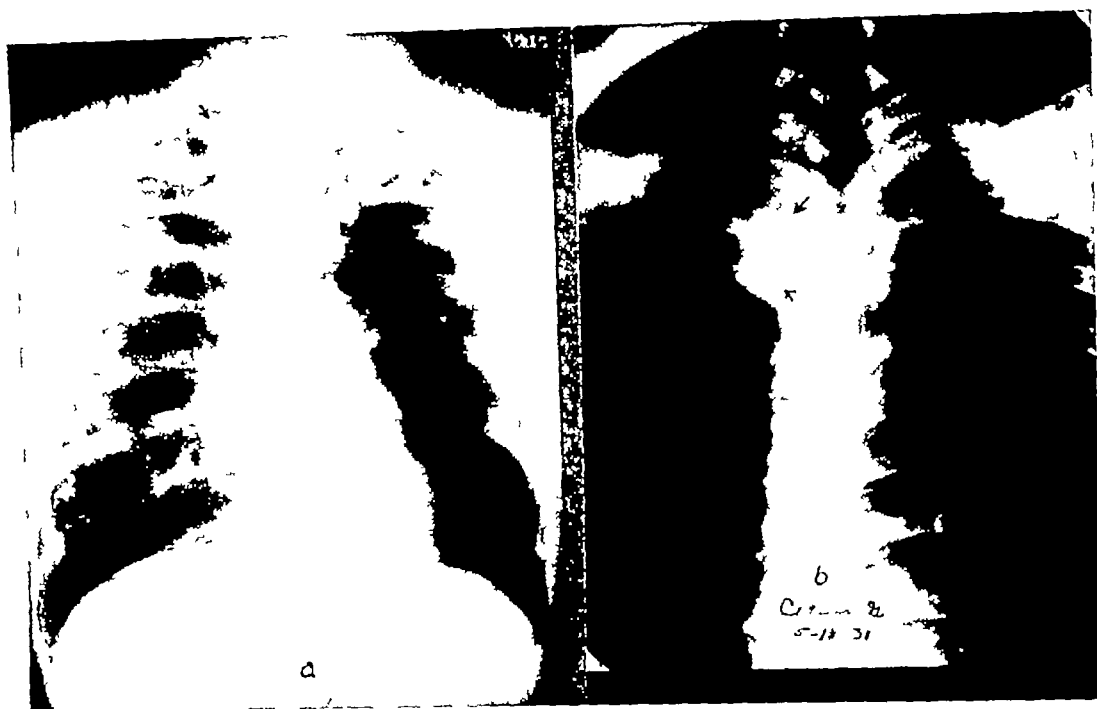
Figs 9 A and 9 B Case IX J T, No 272 038 female aged 16 years Fibrinoma (pulmonary tuberculosis pneumothorax) Fig 9 A Appearance on July 13 1932 Fig 9 B Partial organization with reduction in size Oct 4 1932

Hospital two patients have presented echinococcus cyst of the pleura. One had been considered a case of pulmonary abscess and secondary empyema. Only when viewed in the lateral and oblique projections (Case VI, Figs 6-A and 6-B) was the fusiform encapsulated character demonstrated along the interlobar fissure. A history of the expectoration of typical "noodle" shreds from the cyst wall aided in a positive pre-operative diagnosis. On operation, the tumor was found to be firmly encapsulated in the fissure. The other patient presented a more typical round homogeneous tumor in the lower part of the right long fissure, with no evidence of extension from a subphrenic involvement. Both patients have remained well over two years following surgical removal of their tumors.

Roentgen differentiation from any other roundish encapsulated tumor in the thorax may not be possible. Careful search for a history of exposure to the parasites, serologic study, and evidence of other lesions

must be employed for positive diagnosis. On the other hand, recently a patient presented a classical round shadow, as of a cyst encrusted with calcium, in the right lobe of the liver, and a round homogeneous tumor in the lower right lung, with a history of possible exposure to the echinococcus. Biopsy of the kidney revealed a very primitive type of hypernephroma (Figs 7-A and 7-B, Case VII), which histologically, would not suggest a papillary cystadenoma of the kidney.

3 In tuberculous infections of the pleura there appear occasionally on the roentgenogram sharply circumscribed areas of evident increase in density, apparently sessile tumor masses lying close to the thoracic wall. Within these there may be some flocculent shadows of calcium. Save for the relatively sharp margination and lack of evidence of coalition of multiple tubercles, one might consider a localized confluent subpleural pulmonary tuberculosis (Case VIII, Figs 8-A and 8-B). Upon study at the autopsy table they are found



Figs 10 A and 10 B Case X C G, No 255 264 male aged 19 years Aneurysm of innominate artery
 Fig 10 A Routine chest examination, small mass, median portion right apex poorly visualized in this view Fig 10 B Detail (Potter Bucky diaphragm), sharp demonstration of tumor mass

to be definitely encapsulated soft tumors in or beneath the pleura (parietal in the case cited), with a firm fibrous capsule and containing a creamy, greenish-yellow débris. Such is the appearance of the tuberculoma of the thoracic wall.

4 The other tumor appearing in the tuberculous patient is to be found chiefly with the chronic pleural effusion of tuberculosis. Such a tumor is found, on autopsy or thoracoscopy, to be a more or less organized mass of fibrin, a fibrinoma. It may be adherent to the parietal or visceral pleura, more commonly at about the surface of the effusion in an hydropneumothorax, may dangle in the fluid, or be suspended between the lower tip of the lung and the diaphragm. Occasionally such tumors lie free in the pleural space, and hence may be found in any one of several positions, dependent on the posture of the patient at the time of the exposure of the film. They are homogeneous masses, to be confused at times with true neoplasms or proliferative disease of the

parietal pleura. So far as we know, they have no clinical significance (Case IX, Figs 9-A and 9-B).

(b) The tumors of the pleura of intrinsic origin are quite rare. These are chiefly endotheliomas and the connective tissue tumors, such as chondromas of the phrenic pleura.

(1) Endothelioma of the pleura presents a very confusing complex. The prolonged clinical course may be divided into three phases. The initial period may or may not be accompanied by pleural pain, there is usually some effusion and slight fixation of the thoracic wall on the affected side, but without cough, other pulmonary symptoms, or leukocytosis. In the second period the fluid re-accumulates rapidly after thoracentesis, the fixation proceeds definitely, still without leukocytosis in contra-distinction to the effusion with pleural infection. The fluid may be sanguineous in character and tumor cells may appear in the sediment. In the third period, fixation of the visceral



Figs 11 A and 11-B Case XI C B, No 279 994, male aged 30 years Primary chondroma of lung
Fig 11-A Frontal view Fig 11-B Lateral projection, tumor lying between the pleurae and the fissure.

and parietal pleura usually appears. The effusion, pushing against a rigid thoracic wall, may induce a mediastinal shift. Mediastinal, axillary, and contra-lateral metastases appear.

If diagnostic pneumothorax or thoracoscopy is employed, the pleura will show multiple low nodular elevations at first, with subsequent gross thickening of the pleura and pleural fixation. The invasion of the homolateral lung will take place chiefly along the lymph spaces in the septa.

Ewing believes there may be two types of different origin, one arising from the endothelium of the lymph spaces and invasive in type, the other of superficial origin in the lining cells of the pleura, producing nodular masses. The vascular proliferation, nodular arrangement of the cells with caseation, and the presence of giant cells of the Langerhans type may give rise to confusion with hemorrhagic tuberculous pleurisy.

From the roentgen appearance alone, differentiation from tuberculous pleurisy, metastatic carcinoma of the breast, empyema, or extensive neurofibromatosis may be quite difficult. Clinical data and roentgenographic signs, with induced pneumothorax, must be weighed carefully.

(2) Occasionally small connective tissue tumors may arise in the outer layers of the pleura. It is improbable that these can be differentiated by roentgen methods. The small chondromas of the phrenic pleura seem to be the more common—not to be confused with the "pulmonary chondromas" which, apparently, are of embryonal origin.

III —THE THIRD MAJOR GROUP

This is a miscellany of those lesions which properly do not arise from the thoracic wall or pleura, but which may present roentgen changes by pressure or invasion in the wall or pleura. These are



Figs 12-A, 12-B and 12-C Case XII W S No 318,498, male, aged 43 years Primary carcinoma of the pulmonary apex (Primary sulcus tumor) Fig 12-A Frontal projection, obscuration of right pulmonary apex, questionable changes first rib Fig 12-B Detail, cervico-thoracic junction, showing destruction by infiltration of the first rib and seventh cervical transverse process Fig 12-C Detail of pulmonary apex showing rib destruction and tumor

chiefly aneurysms of the innominate artery, newgrowths from embryonal rests, and the so-called "superior pulmonary sulcus tumor" (which is probably a primary carcinoma from the pulmonary apex)

(a) Aneurysm of the innominate artery may obscure only the pulmonary apex, simulating a thyroid tumor, but may also develop a very large globular mass similar to a gross pulmonary cyst, gross neurofibroma, or any other large mass (Case X, Figs 10-A and 10-B) Adequate study by clinical and fluoroscopic methods, with detail films, should permit differentiation—the advent of roentgen kymography may prove of value in the identification of these lesions Destruction of the contiguous bony thorax is rare

(b) The major number of newgrowths arising from embryonal rests in the thorax appear in the mediastinum, and will be discussed by other essayists in this sym-

posium Occasionally a subpleural teratoma will develop to the right or left of the sternum Differentiation may be extremely difficult by roentgen methods Invasion of underlying lung, or compression, may induce pulmonary infiltration or pressure atelectasis sufficient to mask the primary lesion If the tumor should contain some osseous fragments or if rupture into a bronchus should occur, with expectoration of hair or sebaceous detritus, diagnosis may be more positive

The teratoids are not so definitely circumscribed as the myxo-lipo-chondromas (echondromas) These are more commonly found nearer the hilum than in the pulmonary parietes Hickey and Simpson's case contained appreciable calcium One of the cases (Case XI, Figs 11-A and 11-B) which the author reported with Benninghoven contained no gross calcium, was extra-pulmonary in the lower right

thoracic quadrant, and intimately attached to the visceral pleura. They are more or less homogeneous, depending upon the amount of calcium content, relatively sharply circumscribed, and may have a slightly crenated margin. Histologically, they contain cartilage (predominantly), with some lipid, myxomatous and lymphoid elements in scattered areas. These are probably of embryonal fragment origin rather than metaplasia of the connective tissue elements, the latter being more probable in the case of the local chondromas which appear beneath the diaphragmatic pleura. The intrathoracic chondromas may have no clinical significance except as they become large enough to induce pressure signs and sequelæ in the lung.

(c) With the mention above of aneurysm of the innominate artery, some attention must also be given to the so-called "superior pulmonary sulcus tumor." This has been described as a tumor in the apex of the thorax, associated with more or less intense pain in the shoulder and down the arm, Horner's syndrome, destruction of contiguous bone, and atrophy of the hand muscles on the affected side. Pancoast believes that its origin from either lung, pleura, ribs, or mediastinum has not been established, and suggests that the terminology might be revised with further knowledge of the histopathology. Recent necropsy evidence in our clinic, as reported by Jacob, leads us to feel that this is really a mucin-forming primary adenocarcinoma arising from the bronchi of the pulmonary apex. It usually involves the pleuræ and invades the paravertebral soft tissues and bony thorax locally. Metastasis in the suprarenal was found in Jacob's case. Similar pain may be associated in some measure with innominate aneurysm; the obscuration of the pulmonary apex with aneurysm may simulate the infiltration of the neoplasm, and the changes of the Claude Bernard-Horner syndrome may be induced by any lesion which can effect a

paralysis of the sympathetic on the affected side. However, only neoplasm could cause the destruction of rib or vertebra which commonly appears with the primary carcinoma of the pulmonary apex (Case XII, Figs 12-A, 12-B, and 12-C).

Roentgen Examination—Occasional reference has been made in the discussion above to the methods of roentgen examination in these tumors. Any patient exhibiting signs of changes in intrathoracic pressure as manifest by disturbance of circulation or respiratory embarrassment should be examined first by fluoroscopy.

As a routine procedure the basic film studies should include a stereoscopic frontal and a lateral projection. The fluoroscopic study and basic films may then be supplemented by further projections in one or more oblique planes or, with the patient recumbent, in such a position as seems to most clearly project the involved area.

The lateral view of the thorax has been occasionally used by roentgenologists for some time. Since 1930 we have made it a routine measure in any case of suspected thoracic wall or intrathoracic tumor.

The Potter-Bucky diaphragm has also proved of value in these lesions, although I believe it need be used only in special detail examinations.

In the roentgen study of patients under consideration for thoracic surgery, we find the induction of a pneumothorax and subsequent films of very valuable assistance in the differentiation of an extrapulmonary mass, and an excellent method by which to demonstrate any possible fixation of visceral to parietal pleura at the site. Such examination can be done at the time of preparation of the patient for thoracic surgery.

In conclusion, this series of tumors includes a most diverse and relatively rare group in which differential diagnosis may require extensive and critical clinical study in conjunction with thorough roentgen examination.

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CONGENITAL CYST OF THE LUNG¹

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CONGENITAL cysts of the lung, though not frequently encountered, present a pathologic condition important in the differential diagnosis of chest conditions. The following theories have been advanced as to the etiology of congenital cysts: (1) Bronchial maldevelopment—a defective embryologic development of the bronchi resulting in complete or incomplete stenosis of the main bronchus or bronchi, usually of the upper lobe, with distal dilatation of the end branches, (2) alveolar agenesis—defective embryologic development of the alveolar tissue which leaves the bronchi unsupported and consequently causes them to become unduly dilated, (3) defective embryologic development (anlage) of the lymph vessel systems of the corresponding lung.

The cysts may be filled with fluid if the deformed bronchus is completely occluded, if incompletely stenosed they will contain air. While the pathogenesis of congenital cysts can only be surmised, the theories may be of some value in elucidating the pulmonary cystic changes encountered. Clinically the following conditions, amongst others, may be simulated by these cysts:

(1) *Bronchiectasis*—The congenitally dilated bronchi and bronchioles may retain some mucosal secretions, and if the latter become secondarily infected it may be impossible to differentiate the congenital sacculations from the acquired form, unless the history of the case is clear or the sacculations are so extensive as to point to a universal bronchiectasis.

(2) *Pulmonary Atelectasis*—The alveolar agenesis affecting a whole lung leads to

its arrested development with consequent narrowing of the intercostal spaces, elevation of the diaphragm, and displacement of the heart and mediastinum to the affected side, which on the roentgenogram appears as a unilateral opacity. Lipiodol injection will demonstrate extensive sacculations in contradistinction to acquired massive pulmonary atelectasis in cases in which the main bronchus is completely obstructed.

(3) *Spontaneous Pneumothorax*—(a) Localized, silent—in cases in which the cystic changes involve a whole lobe or the greater portion of it and the congenital stenosis of the bronchus is such that ingress and egress of air are free, the cyst will contain air, and on the roentgenogram it will resemble a localized pneumothorax (or perhaps cavitation), (b) valvular—in cases in which the congenital stenosis of the bronchus is such that egress of air is interfered with while ingress is free. The mechanism is that of obstructive emphysema, owing to a check-valve obstruction wherein with each respiration more air becomes incarcerated in the sub-jacent lung, which dilates and presses upon the mediastinum and the heart, displacing them to the unaffected side, the contralateral lung is thus encroached upon.

In infants, owing to the labile mediastinum and the delicate rib cage, the symptoms, as pointed out by Miller (1), Nelson (2), Parmelee and Apfelbach (3), Croswell and King (14), may become alarming, with acute attacks of dyspnea and cyanosis simulating clinically valvular pneumothorax. The affected side is hyper-resonant or tympanic on percussion; on auscultation, the breath sounds are absent, heart and mediastinum are displaced to the opposite side, and on thoracentesis there is an escape of air under pressure. However, the roentgenogram fails to show

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any evidence of a collapsed lung, the entrapped air being intrapulmonary

Wilson (4) reported a case of obstructive emphysema in an adult, probably due to congenital cystic disease, in which periodic attacks of dyspnea were so severe as to necessitate repeated withdrawals of air in amounts varying from 300 to 700 c.c., with initial reading around minus 1, plus 1, final reading minus 7, minus 3, depending on the amount withdrawn. That he was dealing with a congenital air cyst and not with a spontaneous pneumothorax was demonstrated by the fact that after an induction of an artificial pneumothorax, the outlines of the partially collapsed lung could be discerned. It is thought that in such cases the main bronchus is the seat of an incomplete stenosis whereby more air is allowed to enter on inspiration than can escape on expiration, so that with each succeeding breath more air is retained in the cyst.

According to Eloesser (5), cysts of the lung may be solitary or multiple or one entire lung may be the seat of cystic degeneration. The writer (6) is of the opinion that, in the last form, the physical and especially the roentgenologic findings may simulate pulmonary atelectasis: the unilateral hemithorax is shrunken, intercostal spaces are narrowed, the homolateral dome of the diaphragm is elevated, and there is displacement of the trachea, heart, and mediastinum to the affected side. On percussion this side is dull, while on auscultation an enfeeblement of the breath sounds is noted, although occasionally tubular breathing and squeaks are elicited. The roentgenogram simulates pulmonary atelectasis. Over-exposure of the film may show transradiant areas, while lipiodol injection will demonstrate extensive sacculations occupying the whole lung. It may be difficult to determine whether these sacculations are congenital or acquired in character and secondary to chronic shrinking tuberculosis, chronic partial bronchial stenosis, or chronic pleurisy and emphysema. However, laboratory data and the history assist in differen-

tiation, as in the case reported by Hermes and Mumme (7) in which the heart was noted on the right side by the mother early after birth although an electrocardiogram failed to substantiate dextrocardia, the roentgenogram showed a typical appearance of pulmonary atelectasis with cardiac displacement to the right. Lipiodol injection demonstrated extensive sacculations, regarded by these authors as due to congenital maldevelopment of the bronchi and alveoli.

A review of the literature on the subject of congenital cysts of the lung suggests that the types encountered may be grouped as follows:

1 Symptomatic

- (a) Those presenting symptoms and signs simulating valvular pneumothorax wherein the mechanism is that of obstructive emphysema
- (b) Cystic degeneration of a whole lung simulating pulmonary atelectasis (Tillotson, 8, Eloesser, 5, and Hermes and Mumme, 7)
- (c) Fetal bronchiectasis simulating the acquired form
- (d) Congenital retention cysts secondarily infected and brought to attention on account of acute or subacute pulmonary disease (Harrington, 9)

2 Asymptomatic

- (a) Solitary or multiple cysts with an open bronchial connection, these may only be discovered accidentally

We present five cases, four of which may be regarded as typical, and the fifth as highly suggestive of this condition.

CASE REPORTS

Case 1 S A J, a white male, height, 5 feet 8 inches, weight, 133 pounds, age, 42

years, ambulant, a painter and paper-hanger by trade, was admitted to the Veterans' Administration Facility, Memphis, Tennessee, for the treatment of bronchiectasis with air cysts of both lungs. Family history was irrelevant. His personal history was as follows. The patient, besides having had the ordinary diseases of childhood, suffered an attack of pneumonia while with the A E F (air squadron) in France, had an appendectomy in 1917, influenza in 1918, and pneumonia again in 1928. He denied syphilis or neisserian infection. One week prior to admission to the Veterans' Hospital, the patient was bronchoscoped at the Memphis General Hospital, where lipiodol was instilled. On admission, he complained of a hacking cough and shortness of breath, more marked on walking. These symptoms had troubled the patient since 1918 but only lately became aggravated. A physical examination revealed the following: the patient showed moderate dyspnea on slight exercise, with no cyanosis. His head and neck were apparently negative. The chest was asymmetrical, the right hemithorax seemed smaller than the left, with the right shoulder somewhat drooping. Both supraclavicular fossæ, especially the right, were accentuated, and mobility of the chest wall was slightly restricted on the right side. On percussion of the right lung, impaired resonance was elicited at the upper apex and infraclavicular region to the fourth interspace, also impairment of the resonant note from the upper apex to the infra-scapular area and at the midaxillary area. Auscultation of the right lung showed breath sounds suppressed at the upper apex and infraclavicular area to the third interspace, also at the supraspinous fossa, no râles or friction rubs were heard on deep inspiration or coughing. In the left lung the percussion note was normal, the breath sounds were slightly accentuated throughout, and the whispered fremitus was normal. At the lower base on deep inspiration, dry râles were obtained which persisted after coughing. The heart was negative, blood pressure, 125/80. The

remainder of the physical examination showed no abnormal findings.

A re-examination of the chest on Feb 19, 1934, elicited numerous coarse râles through both lower lobes, especially at the bases, where mixed dry and moist râles were encountered which persisted after coughing. These râles were heard on periodic re-examinations. Laboratory findings were as follows: admission roentgenogram showed an area of decreased density corresponding to the right upper and middle lobes, with an apparent absence of lung tissue. Pulmonary markings of the right lower lobe and of the whole left lung appeared normal except that scattered lipiodol was seen at bases of both lungs, the trachea deviated to the right, the diaphragm was smooth, the costophrenic angles clear, and the cardiac and aortic shadows were within normal limits. The sputum was persistently negative for tubercle bacilli. Diagnostic pneumothorax performed on the right side, Jan 11, 1934, gave an initial reading of minus 4, minus 5.5, 300 c.c. of air was given, and the final reading was minus 0.5, minus 1.5. This procedure was repeated on Jan 13 and 25, on both occasions resulting in a reduction of the negative intrapleural pressure. A roentgenogram of the chest, taken after the induction of the artificial pneumothorax, outlined the visceral pleura and the compressed intrapulmonary hollow spaces of the right upper and middle lobes.

Clinical course: the patient's temperature, pulse, and respiration stayed within normal limits. His appetite was good, and he gained 25 pounds in weight during his stay in the hospital. It is to be noted that the patient was quite anxious to have pneumothorax treatment continued, stating that his chest felt easier and he was not so short of breath after these air injections—subjective evidence suggestive of a congenital cyst associated with symptoms of mild obstructive emphysema with favorable response to artificial pneumothorax. In the opinion of the attending physician, however, therapeutic pneumothorax was not strictly indicated since the dyspnea



Fig 1 Case 1 (*left*) Admission film shows the following: an area of decreased density, corresponding to the right upper and a portion of middle lobe with apparent absence of lung tissue; scattered lipiodol at the lower lobes; trachea deviated to the right; diaphragm smooth; costophrenic angles clear; and heart and aortic shadows normal.

Fig 2 Case 1 (*right*) Chest film subsequent to induction of artificial pneumothorax shows and outlines the visceral pleura and the intrapulmonary hollow spaces of the right upper and middle lobes.

was rather mild in character. The diagnosis was as follows: congenital cyst of right lung (Figs 1 and 2), with bronchitis, chronic moderate. The patient was discharged as improved on March 25, 1934.

Case 2 L. L., a negro male, 5 feet 11 inches tall, weight 163 pounds, age 53 years, was admitted on July 11, 1934, for the treatment of pneumothorax on the right side, chronic pulmonary tuberculosis, and arterial hypertension. His chief complaints were shortness of breath and wheezing, both of which were more marked at night. There was no history of hemoptysis or loss of weight or night sweats. A physical examination disclosed signs of dyspnea on mild exercise (walking). Chest was symmetrical, with expansion limited on the right side, and palpation was negative. On percussion, resonance was somewhat impaired throughout the right lung while the left lung was apparently normal. On auscultation, the right lung showed diminished breath sounds throughout, whispered fremitus decreased, and obscure dry râles were heard at the midaxillary and infrascapular area. In the left lung, the

breath sounds were accentuated throughout, while whispered fremitus was unaltered, occasional dry râles were heard at the lower base. The heart was within normal limits on percussion. On auscultation, the second aortic sound was accentuated, the heart sounds were of good tone, no murmurs being heard. The blood pressure was 210/130. On fluoroscopic examination, the patient showed increased translucency through the right lung, the left lung seemed normal in appearance. Cardiac and aortic shadows were within normal limits. A roentgenogram of the chest revealed an apparent absence of lung tissue through the right upper and middle lobe with strands instead of the normal pulmonary markings. The left lung seemed negative, heart and aortic shadows normal. Electrocardiogram showed no abnormalities except a deepening of the S-2 and S-3. Patient's temperature, pulse, and respiration were within normal limits. Urinalysis was negative. Blood chemistry showed urea nitrogen 19.6 mg per 100 c.c. The diagnosis was as follows: hypertension (artery), severe, congenital

air cyst of right lung, and bronchitis, chronic moderate

Diagnostic pneumothorax was recommended, but the patient refused and he was discharged from the hospital on Aug 1, 1934. The main point of interest in this case is that we are in possession of the man's records and roentgenograms over a period of seven years. At a previous hospitalization, in 1928, the admission diagnosis of pneumothorax and chronic pulmonary tuberculosis was denied, with the comment that his temperature, pulse, and respiration were normal, and sputum negative. There was an absence of toxemia, no loss of weight and, furthermore, the manometric readings were not those of a pneumothorax. Pulmonary emphysema was suggested. A comparison of the chest films, in 1928, with the recent roentgenograms shows no change, and the absence of lung markings throughout the greater portion of the right lung together with the physical signs indicate congenital cyst of the lung.

Case 3 This case of asymptomatic pulmonary cyst was brought to our attention by a casual chest film. B. H., white male, common laborer, age 42 years, married, with one child living, was admitted to the Veterans' Administration Hospital on Sept 24, 1932, with complaints of nocturia, frequency of urination, dysuria, and partial deafness. The patient's family history was as follows: his father died at the age of 78 of paralysis, his mother and one sister are living and well. His personal history was irrelevant. There was no history of neisserian or syphilitic infection. A physical examination revealed that his head and neck were essentially negative, except for cholesteatoma, bilateral, with marginal perforation of the tympanic membrane. A chest examination showed that there was a slight diminution in resonance of the upper right lobe anteriorly, posteriorly, the resonance was slightly increased in the suprascapular fossa. On auscultation, the breath sounds were diminished, whispered fremitus decreased, while the remainder of the lung examina-

tion including the whole left side was negative. Heart sounds were easily differentiated, no murmurs were elicited and the blood pressure was 120/80. The rest of the physical examination—orthopedic, neuropsychiatric, etc.—was unimportant except for positive findings in reference to the genito-urinary tract resulting in a diagnosis of prostatitis (chronic), moderate and seminal vesiculitis (chronic bilateral). Temperature, pulse, and respiration were normal.

Laboratory data were as follows: Wassermann, urinalysis, blood count, and sputum were negative. On admission, the chest film showed an area of decreased density corresponding to the right upper lobe, with apparent absence of lung tissue and only a few curving strands seen at the first and second interspace. The right hilum was increased in size and density, with slight peribronchial thickening at the middle lobe. The left lung was clear. The diaphragm was smooth, the costophrenic angles were clear, heart normal.

A glance at the chest film might suggest spontaneous pneumothorax or cavitation, however, in view of the negative history and the scant clinical findings, the possibility of congenital cyst of the lung was considered. The following procedures (a and b) were undertaken to substantiate this tentative diagnosis. (a) Diagnostic pneumothorax—an attempt at manometric reading, with insertion of pneumothorax needle under novocain anesthesia at the third interspace near the anterior axillary line (right side), was unsuccessful. The needle was reinserted at the second interspace (right side) but no reading was obtained. When the pneumothorax needle was inserted in the fourth interspace (right side, anterior axillary line), the initial reading was minus 1 minus 2, 100 cc of air was given, and final reading was 0 plus one-half. (b) Lipiodol injection failed to outline the bronchi of the right upper lobe, although caution was taken to have the patient lie on the right side during this injection, the film having been taken in the same position. Roentgeno-

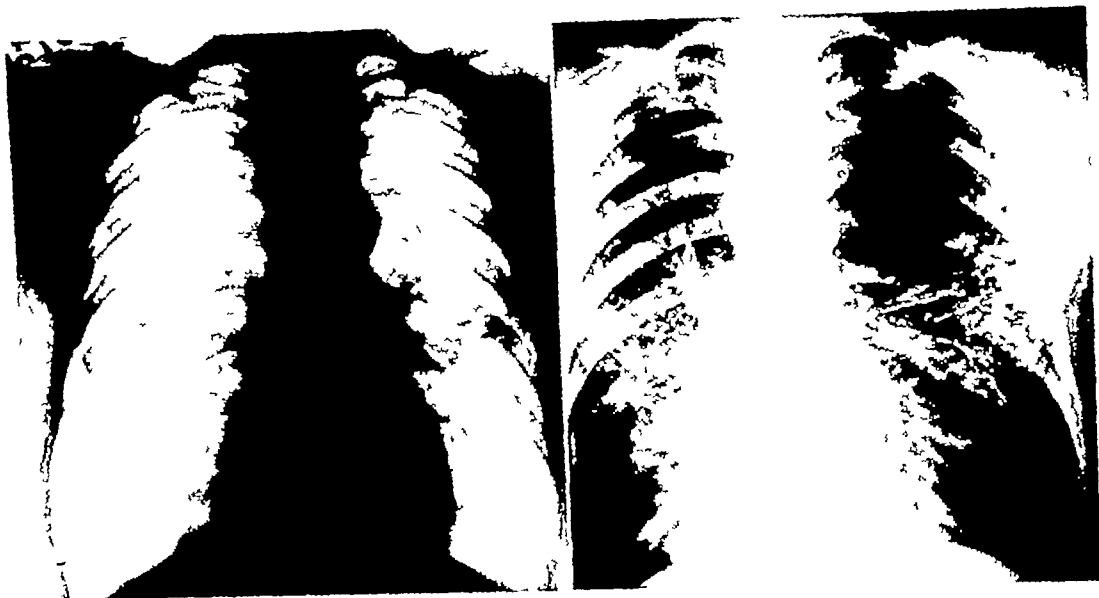


Fig 3 Case 3 (*left*) Roentgenogram made subsequent to the induction of artificial pneumothorax shows a marked collapse of the middle and lower right lobes, with no apparent effect upon the hollow space in the region of the right upper lobe

Fig 4 Case 3 (*right*) Roentgenogram made subsequent to lipiodol injection in accordance with the method advocated by Faulkner and Faulkner fails to outline the upper lobe bronchi, while the bronchi of the right middle and lower lobes are well outlined. Right middle and lower lobes show almost complete re-expansion. Intrapulmonary hollow in the region of right upper lobe remains unchanged

grams made after injection showed marked collapse of the middle and lower right lobe induced by the artificial pneumothorax, which apparently had no effect upon the hollow space in the region of the right upper lobe (Figs 3 and 4, Case 3). It is to be noted that the patient, while co-operative, was not enthusiastic about these procedures, maintaining that there was nothing wrong with his chest. He was discharged from the hospital on Nov 14, 1932, and a check-up chest film prior to discharge showed complete expansion of the right middle and lower lobes with no demonstrable change in the area occupied by the right upper lobe. He was readmitted to the hospital on March 2, 1933, for the treatment of his prostate trouble, and while undergoing treatment in the G-U ward, it was thought advisable to check up the chest findings. Both physical and roentgen examinations showed no change in comparison with those on his previous admission to the hospital. Pleuracentesis on April 21, 1933, with the pneumothorax needle at the second inter-

space (right side) in the region of the hollow space, gave the following: Initial reading minus 1 minus 3, 150 c.c. of air was given, and the final reading was minus 1 minus 2. The needle *in situ*, connected with a syringe, was inserted deeper and 2.5 c.c. of lipiodol was injected. Subsequent fluoroscopic and roentgenographic examinations showed retention of the lipiodol in the hollow space, delineating adjacent curving strands; there was an induced pneumothorax affecting the middle and lower lobes, while the region of the upper lobe was apparently unaffected. The extent of the induced pneumothorax seemed, as in the former sitting, out of proportion to the amount of air injected; it is possible that the production of a pleuropulmonary fistula accounted for some of the air present, although no untoward symptoms ensued. A roentgenographic examination two weeks later showed retention of the lipiodol at the point of injection and complete disappearance of the induced pneumothorax (Fig 5). This patient was rehospitalized in

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shortness of breath, and loss of strength. A physical examination, on general appearances showed that the patient was a well developed, somewhat undernourished white male, height, 5 feet 11 inches, weight, 134 pounds, age, 38 years. He was ambulant and showed no marked dyspnea or cyanosis on mild exercise. His physical examination was negative except for the following positive data: the mobility of the left chest wall was greatly restricted as compared with the right side, which was normal on percussion and auscultation. The left lung presented diminished tactile fremitus and moderately impaired resonance from the upper apex to the lower base which was 2.5 inches higher than the right base, the percussion note at the left lower base showed no change on deep inspiration, while on auscultation of the left lung, the breath sounds were roughened at the infraclavicular area and lower base, whispered fremitus was increased, and occasional dry and moist râles, which disappeared on coughing, were heard at the infrascapular region. The admission roentgenogram showed the left lung to be greatly reduced in size as compared with the right lung which appeared hyperaerated, the left dome of the diaphragm was about three inches higher than the right, the left costophrenic angle was obliterated, and the left lung showed circular areas of lessened density, especially at the lower lobe, which after lipiodol injection appeared like grape sacculations. The heart was deviated to the left. The clinical course was unremarkable and temperature and respiration were within normal limits, his pulse being 86-90. Laboratory findings showed the following: sputum persistently negative for tubercle bacilli, sedimentation test normal, blood count and Wasserman test negative. An attempt at a manometric reading was made at the fifth interspace midaxillary line on the left side. Some difficulty, however, was encountered in passing the needle through a thickened pleura, and no oscillations of the manometer were obtained, although the procedure was repeated twice (Fig. 6). The diagnosis was

as follows: bronchiectasis, congenital(?), with atelectatic effect.

SUMMARY AND DISCUSSION

In the differential diagnosis of congenital cyst of the lung the following conditions were considered:

(a) Spontaneous pneumothorax (Cases 1 and 2),

(b) Cavitation—involving a whole upper lobe (Cases 3 and 4),

(c) Bronchiectasis, acquired (Case 5),
(a) *Spontaneous Pneumothorax*—The following points tend to exclude this:
(1) The compressed lung cannot be seen fluoroscopically or roentgenographically.
(2) X-ray and physical signs remain unchanged over a long period of time—in Case 2, over six years' observations.
(3) Thoracentesis, with lipiodol injection (2.5 c.c.) through the center of the apparently structureless space on subsequent radiographic examination, shows the bulk of the lipiodol retained at the point of injection with only slight scattering accentuating the adjacent curving strands. Had there been a pneumothorax, the lipiodol would have gravitated to the lowest point of the hollow space on assumption of the erect position by the patient.
(4) Diagnostic pneumothorax in Case 1 rendered possible subsequent roentgenographic visualization of the visceral pleura (and the compressed intrapulmonary hollow spaces) of the right upper and middle lobes, thus excluding spontaneous pneumothorax. In Case 3, diagnostic pneumothorax failed when the pneumothorax needle was inserted into the second and third interspaces (anterior axillary line), it was successful, however, at the fourth interspace (midaxillary line) and at the center of the apparently hollow space. As shown by the films (Figs. 3, 4, and 5), the induced pneumothorax affected the middle and lower lobes, while the region of the upper lobe remained unchanged. This finding apparently indicates an obliter-



Fig 5 Case 3 (left) Roentgenogram shows retention of the lipiodol at the point of injection in the region of the intrapulmonary hollow and complete re-expansion of right middle and lower lobes

Fig 6 Case 5 (right) Roentgenogram shows grape like sacculations in left lung subsequent to lipiodol injection, left lung is reduced in size left dome of diaphragm is elevated and the heart and mediastinum are deviated to the left

January, 1934, for the treatment of purulent otitis media. Physical and x-ray re-examinations of the chest showed the same findings as on the previous admission.

Case 4 This case is similar to the preceding one except that it illustrates the co-existence of two pathologic entities in the same chest which may be confusing. Records show that this man, C L, on examination in May, 1931, had signs referable to his right upper apex, manifested by impaired resonance and moist râles. In addition, there was a history of loss of weight, cough with some expectoration, and slight evening rise in temperature. On re-examination 12 months later, there was a complete arrest of the tuberculous process at the right upper lobe previously diagnosed as chronic pulmonary tuberculosis, minimal, class A symptoms. However, a recheck of the roentgenogram taken at the first examination with one a year later showed persistence of the area of decreased density at the left upper lobe measuring about 6 cm in diameter, while the right upper apex presented only a few fibrotic strands. The final diagnosis was

chronic pulmonary tuberculosis, apparently arrested, of the right upper lobe, a congenital cyst of the left lung, asymptomatic. The final roentgenogram of the case to all intents and purposes is identical with that of the previous case described except that the location of the air cyst is on the left side.

Case 5 C F R, a farmer by occupation, was admitted for examination and observation to the Veterans' Administration Facility, June 7, 1933, with a history of chronic pulmonary tuberculosis. The patient's family history was as follows: his father is living and well, his mother died of acute "indigestion" at the age of 35, three brothers and two sisters are living and well. There was no history of tuberculosis or cancer in the family. His personal history revealed that he had besides the ordinary diseases of childhood, pneumonia at 14, influenza in 1918, 1922, 1928, 1930; chronic pulmonary tuberculosis since 1919, and an appendectomy in 1931. The patient denied any venereal infection. His complaints on admission were cough, with expectoration especially in the mornings,

I think we can say definitely, has a congenital cyst of the lung. This child had symptoms at birth which were interpreted

and air replaced in the pleural cavity, which demonstrated this peculiar cystic appearance in the lung itself (Fig 1-B)

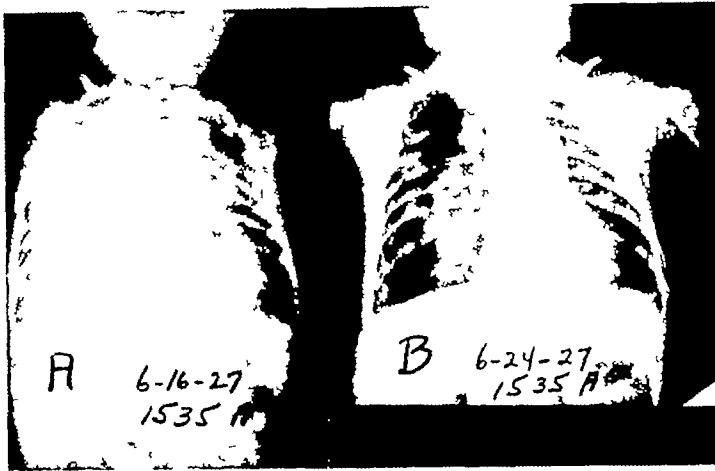


Fig 1 Case of true congenital cyst of lung. A shows fluid in right hemithorax, B shows replacement of fluid with air



Fig 2 Same case as shown in Figure 1. A shows injection of opaque medium into right lung cyst. B shows lateral view. Note outline of lobes and clear separation from thoracic wall

as being due to congenital atelectasis or possibly an enlarged thymus. A roentgen examination at that time showed it was not, the mediastinum being displaced to the other side, if anything, and the suggestion that there was fluid of a rather peculiar character was made at that time (Fig 1-A). Aspiration was done a week or two later

We later injected opaque medium directly into the lung. You can see here (Fig 2) the formation of the lobes, indicating that the opaque medium went into the lung itself, and demonstrating clearly that we were dealing with a congenital cyst. This child was operated upon, got along very well, but, following a bronchoscopy to

ated pleural space in the region of the right upper lobe, and, of course, rules out a diagnosis of localized pneumothorax. The case reported by Hermes and Mumme (13) showed that at autopsy, "the whole right upper lobe is attached to the chest wall by adhesions. Its parenchyma is occupied by a system of multiple cavities or cysts varying in size, etc." In such a case it would evidently be impossible to outline the visceral pleura of the right upper lobe by an induced pneumothorax. Similar pathology, it is believed, exists in Case 3, described above.

(b) *Cavitation*—When the clinical findings in Cases 3 and 4 are considered together with the roentgenograms, it becomes evident, as in the cases reported by Siems (10), that the intrapulmonary hollow spaces are not cavities due to the processes of disintegration.

(c) *Bronchiectasis, Acquired*—The history of chronic pulmonary tuberculosis in Case 5 and perhaps the presence of an obliterative pleurisy on the bronchiectatic (atelectatic) side might suggest the acquired form. There is, however, one fact about this case which points to a probable congenital origin, *ie*, that lipiodol injection in the left lung failed to outline the small bronchi of the lower lobe and those of the peripheral zone. The appearance of this lung after bronchography suggests bronchial maldevelopment rather than bronchiectasis. Furthermore, in Case 3, although care was taken to have the patient lie flat on the right side during the injection in accordance with the method advocated by Faulkner and Faulkner (11) bronchography failed to outline the right upper lobe bronchus. This and the lack of outline in the lower lobe bronchi in Case 5 would seem to support the opinion of Wolman (12) that these cystically dilated bronchi and alveoli (due to congenital maldevelopment) form a closed system or systems wholly or partially discontinuous with the main bronchi.

I wish to express my appreciation to Dr Philip B. Matz, Chief Research Sub-

division, Central Office, Washington, D. C., for his helpful criticism of this paper.

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DISCUSSION OF PAPERS IN SYMPOSIUM ON THORACIC NEOPLASMS

DR LEO G. RIGLER (Minneapolis)
There has been so much presented here that it is very difficult to confine oneself to the few things that the remaining time permits. I do want to make a few comments on some material that perhaps has not been emphasized as much as it might be.

First is the question of cysts of the lung. When we see a patient come in without any previous history, with or without symptoms, presenting a cavity in the lung, the tendency is to call it a congenital cyst. This is not entirely justified, however, because there is such a thing as an acquired cyst of the lung, which might be the case in any of these, and I have a few cases just to illustrate that point.

The first one (Fig 1) is a young child who,

evidence of lung markings within it at all. It is very similar in appearance to those cases that Dr. Dubrow showed and yet



Fig 5 Same case as shown in Figures 3 and 4, one month later, showing development of consolidation in right upper lobe with improvement in left upper

undoubtedly in this case this is an acquired cyst. There is no further fluid in there. He has no sputum or anything of the kind. He has some type of cavitation in the lung

in those cases in which we are certain it is congenital, we can call it that, and in other cases in which we are certain it is acquired, we can call it that, and in those in which we are not certain, perhaps we should leave the terminology to the future.

I just want to say a word or two about the primary tumors of the lung. We have obtained a great deal of assistance from the use of iodized oil. We give it ourselves by the passive method. In our hospital, at least, bronchoscopy has not produced the brilliant results reported in Philadelphia, so that the iodized oil examination has been a very helpful thing in making certain the diagnosis of this condition which is certainly very difficult to be sure about.

I want to show one film which demonstrates very beautifully the virtue of this examination. This was made under the roentgenoscope by Dr. John Eneboe, one of my former assistants, who had given the iodized oil, gotten it into the bronchus and then secured this film (Fig 7) before it was expelled, showing the typical filling defect in the bronchus which is so characteristic

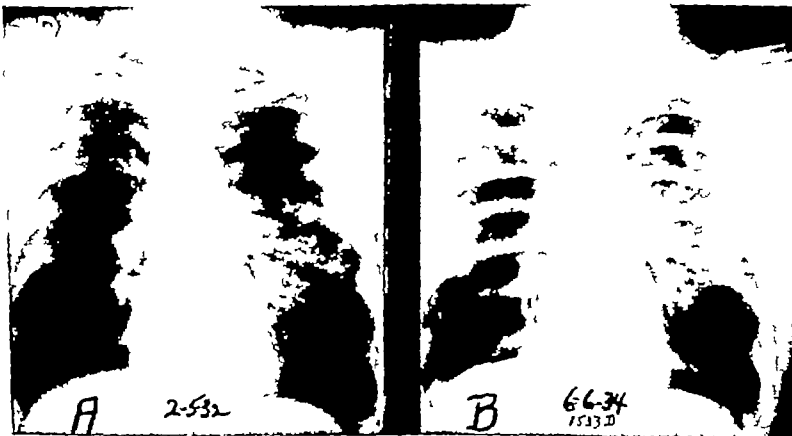


Fig 6 Same case as shown in Figures 3-5, showing development of lung cyst. A postero anterior view with iodized oil six months after acute condition. Note large cavity without fluid in left upper lobe. Iodized oil did not enter into cavity. B, similar condition two years later with patient entirely symptom free.

which arose as a result of this inflammatory process in the first place.

So I think we should confine our term to cystic disease of the lung, a fair term to use,

We also, of course, have demonstrated complete obstruction in some cases and in other cases, in which the tumor was of markedly peripheral origin, the absence of



Fig 3 Case of acquired lung cyst. First examination showing extensive pneumonia left upper lobe with beginning cavitation

demonstrate that it was a bronchogenic cyst, for no apparently adequate reason the child died

tion very early in the course of the disease, and had staphylococci in the sputum. In many of these cases staphylococci are also found in the blood stream

Here is the same patient (Fig 4) a short time later and you see the development of these large cavities. Here is a lateral view (Fig 4-B) and this very large cavity here, well made out, with the fluid level in it. When we saw the same patient, still some time later, there was a little re-accumulation of fluid, a small lesion on the right side also, then here it is (Fig 5) about six weeks from the onset of the illness—a large lesion on the right side and that on the left beginning to resolve and showing a large cavity above

Here is the same patient the following year (Fig 6-A), with this very large cavity in the upper lobe. This appears to be quite typical of the appearance we see in these patients who present themselves with a cavity, which apparently arose out of a clear sky or in which no particular previous illness can be assigned. He was given 10-



Fig 4 Same case as shown in Figure 3 two weeks later. A shows postero-anterior view with large cavities and beginning consolidation in right upper lobe, B shows lateral view with fluid levels in cavities

Here is another type of case entirely (Fig 3). This man came in with what Dr. Reimann, who does most of our work on pneumonia, calls a staphylococcal pneumonia. Some people might prefer to call it acute, multiple lung abscesses. He had symptoms of pneumonia, developed cavit-

dized oil, which failed to enter into the cavity but did enter the lower bronchus

This is the same patient several years later, the film made early this year (Fig 6-B). He is entirely symptomless, has no physical findings, but he has still this large cavity in the upper lobe without any

or bullæ—hardly probable when all clinical data are concerned

Roentgenographically, it is possible for an emphysematous bleb or bulla (from a previous infection and adhesions) to simulate a cyst, but the case presented by Dr Rigler, judging from the history and the physical findings, suggests cavitation. It is possible to differentiate between a cavity and a cyst by thoracentesis and lipiodol

injection through the apparently structureless space. While in a cavity the lipiodol will gravitate downward, in a cyst with its honeycomb structure, the lipiodol will stick at the point of injection, as demonstrated in one of the cases. I do think that it is perhaps preferable to use the term "polycystic disease" or "cystic changes of the lungs" without much emphasis on the word "congenital."

any involvement of the primary larger bronchi

Just one more word about metastasis



Fig 7 Bronchogenic carcinoma of right upper lobe bronchus. Defect in bronchus demonstrated by iodized oil

Our experience has been very different from that of Dr Farrell in the site of origin of the metastases. We very rarely see a metastasis to the lungs from the gastrointestinal tract, very rarely from the prostate. I have not any figures so that I can not quote this accurately, but I have a clear-cut impression that metastases from the gastro-intestinal tract or prostate are relatively rare in the lungs, while of course we do see a great many from the breast and various other organs.

It has been our experience that the appearance of metastases in the lung, especially the nodular type, is more pathognomonic than almost any other lung lesion. We are certainly in error occasionally in describing definitely a tuberculosis or a pneumonia or whatnot in the lungs. That is, we are in error as to the exact etiology of the condition, but it is very rare that one is in error, when a typical metastasis appears, in describing it.

We do see a few rare cases of what the Germans called the *rund herde* or round focus type of tuberculosis, which simulates

metastasis very closely. In those cases some error might occur. Otherwise, it has always seemed to me that there is hardly anything more characteristic than the roentgen appearance of pulmonary metastasis.

DR WILLIAM E ANSPACH (Chicago) I just want to say a few words about the early development of some of the cyst-like cavities that are seen in chest roentgenograms.

It seems to me that it is unwarranted to assume that a solitary or cluster of air-containing cavities with symptoms dating back to infancy, such as Dr Dubrow has shown, are of congenital origin. It has been my privilege to observe quite a number of proved congenital cysts in young children. These were fluid-containing at first and later formed a communication with a bronchus, after which the fluid was replaced by air. Large air cysts tend to trap air, balloon out, and in this manner produce suffocation by compression of functioning lung tissue. Adolescence is rarely attained.

A similar attitude should be taken regarding bronchiectasis. I have been able to follow quite a large group of children through serial roentgenograms and autopsies, from infancy to beyond puberty, and have noted that the development of bronchiectasis occurred in dependent, persisting atelectatic portions of the lung.

These facts support the theory that the majority of cyst-like air cavities in adults are acquired after birth and are not of congenital origin.

DR DUBROW (closing) I am very pleased to see the paper provoked discussion, some adverse and some favorable.

I want to say this much, however, that while we think these cysts are congenital, we could be positive only if we had films of these patients from early infancy. However, these shadows of decreased density demonstrated on the slides, if thought of as acquired in character, should properly be classified as cavities emphysematous blebs.

ticularly the greater curvature. A partial gastric resection with closure of the duodenum and posterior gastro-enterostomy was done. A transfusion was given and the patient was returned to her bed with a permanent venoclysis running into the leg. The post-operative course was uneventful until the fourth day, when a phlebitis appeared at the site of the venoclysis. The cannula was removed and the patient began to take fluids by mouth. Early in the morning of the eighth day, she was seized with a sudden sharp pain in the lower left chest, made a violent outcry, and sat up, becoming pulseless, cyanosed, cold, and clammy for an hour. On recovery, she complained of crampy pain in the lower abdomen, and an x-ray of the chest and abdomen showed some hazing in the lower left lung, with air beneath the left diaphragm. There was no evidence of infarct. Her temperature rose steadily, and she died 21 hours later—on the morning of her twenty-second birthday. An abdominal autopsy showed a rupture of the resection incision at the lesser curvature.

The pathologic report on the resected stomach was carcinoma of the small round-cell type. There was infiltration of all the coats of the stomach.

This case is interesting not only for the presence of cancer in a very young woman but for the unfortunate surgical accident when



Fig 3 A six-hour film

recovery was good and apparently assured. It is to be regretted that autopsy of the chest was denied. This would have determined whether a lung infarct was present, as contended by some who saw the case.

CASE REPORT

CARCINOMA OF THE STOMACH IN A GIRL 21 YEARS OF AGE¹

By W JAMES MACFARLAND, M D,
*Hornell, New York*²

The patient, M M, aged 21 years, first consulted her physician in April, 1933, for a stomach upset with vomiting, which she ascribed to something she had eaten. He found nothing unusual on physical examination and gave her cerum ovalate and antacid, asking her to return for further examination. She

cancer of the stomach, the remainder of the family were alive and well.

Physically, she was a small, thin girl, somewhat undernourished, with a dry tongue. On palpation, there was found a tender mass in the epigastrium in about the position of the stomach, the size being reduced by gastric lavage, and a large amount of undigested food and fluid was obtained.

An x-ray examination the following morning showed the stomach to fill with poor tone and without any waves being seen. The meal



Fig 1 A postero-anterior film of the stomach



Fig 2 An oblique view of the stomach

called him a few days later saying that she was completely recovered.

On Oct 25, 1933, she called her physician again, complaining of continuous vomiting which she had had for one week, at times containing food she had eaten two days before, and also gas and cramplike pains in the upper abdomen. Her past history showed that she had always had stomach trouble and she was described as "picking" at her food rather than eating it. Her mother had died of a probable

stayed entirely on the left side of the abdomen, with a sharp tapered end in place of the usual antral shadow. Pressure on the media, in the manner used to fill the cap, caused a small amount of barium to shoot through a narrow canal and then outline the sphincter and duodenal cap. None of the barium remained in the canal. A mass was then palpated in the filling defect, which was movable and moved with the stomach (Figs 1 and 2). At six hours, there was a large residue with similar findings (Fig 3). At 24 hours, there was still a residue but the patient had vomited.

The patient was operated upon on October 29. A large infiltrating mass was found to occupy the lower third of the stomach, par-

¹The pathologic examination is from the New York State Institute for the Study of Malignant Disease at Buffalo, N. Y.

²I am deeply indebted to the attending physician Dr. A. J. Karl for his help in preparing this case.

For eight months I was associated with the cancer department of a great Jewish hospital. I was told that these emotional persons were difficult to handle and had best not be told the truth. So far as I could discern this was not true. They were, of course, quite intelligent and equally co-operative, whether they were aware of their actual conditions or not.

What is the legal side of the question? I do not know of any statutory or other legal duty to inform the patient of the proper diagnosis, but I am sure that in many States we are forbidden to tell others of the patient's condition, and, should that diagnosis be wrong, we would be liable for damages. Relatives are "others," in that sense. In other words, we are required to exert only due care in making a diagnosis, but we are absolutely liable when we erroneously inform others of a diagnosis and the patient is injured thereby (*Griffin vs Wilkin*, Ohio St Med Jour, Feb 1, 1931, 27, 157). Furthermore, medical ethics demand that we keep the patient's confidences. By what right do we physicians ignore these plain mandates of medical ethics and the law? I do not know.

Perhaps the greatest single obstacle that we meet in applying adequate therapy is the plain and stubborn belief that cancer is incurable. This is furthered by the fact that the diagnosis is rarely exposed until the patient is dead or dying. Even those who have been cured a decade before are prone to conceal the fact. Success in treating cancer, like success in any other field of endeavor, is its own best advertisement. Let us encourage these persons to be living advertisements for advanced medical thought.

Let us analyze these reasons for deceiving the patient. First, the matter of suicide. I stated above that I consider this no more likely than in any other morbid condition, if the patient really has hope. But suppose his condition is hopeless, suppose he has but a few more months to live, in agony, and is a source of discomfort in sight and odor to those about him. What right do I have to prevent that solution by concealing the truth? It would seem to be a rational and sane solution in many cases.

The relatives say that treatment will not do any good—the poor fellow will die anyway. Are they to judge, or is the doctor and the patient? Sometimes the impression is unmistakable that what the relatives mean is that treatment is a waste of money which will otherwise go to them.

And now to the last reason, one not so often expressed but nevertheless operative, particularly in the case of the general practitioner. To diagnose cancer is to commit oneself with certainty to a course of treatment, and if the doctor is wrong quite a few people will know of it. He does not have the opportunity to hedge as in the case, let us say, of lobar pneumonia, so diagnosed, that gets well in two days, in cancer he has committed himself to a course of action. Secondly, his feelings protest against the traumatism to his own psyche when he and the victim have common knowledge of the disease. He is a coward fleeing from his emotion and that of his patients. These two arguments need not be refuted, merely to drag them into the sunlight dissipates them.

CONCLUSIONS

The question, "Shall we tell cancer patients the truth?" is answered by the statement that the physician's first duty is to his patient. Legal duty and medical ethics demand that he be faithful to this concept alone. No evidence can be produced, nor arguments adduced, that deceit contributes to the patient's welfare. On the contrary, reason and experience indicate that here, as elsewhere in human endeavor, honesty is a practicable policy.

FRANK A. RIEBEL, M.D.

Columbus, Ohio

COMMUNICATIONS

RADIATION THERAPY

AT MICHAEL REESE HOSPITAL AND EDWARD HINES HOSPITAL

As occasion may offer, the Editor of RADIOLOGY proposes to visit hospitals and clinics and to publish reports on activities having to do with the use of the x-ray and radium in the treatment of malignant disease. The first sketch is that of the Michael Reese Hospital and the Edward Hines Hospital, Chicago. The idea is to acquaint radiologists with exactly what is being done in regard to the use of the x-ray and radium, from personal observation and experience.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor*

HOWARD P. DOUB, M.D., *Associate Editor*

SHALL WE TELL A CANCER PATIENT THE TRUTH?

The beauty and perfection of truth are so integral with life that he who propounds a deviation from it assumes the burden of proof as to the right therefor. The crassness of deception in the field of cancer diagnosis can hardly be alleviated by considering the pain to relatives, the difficulty in brooking the emotional upset to the patient at the time of telling, or the fact that by making so definite a diagnosis the physician has lost the protection to himself of equivocation—none of these reasons, which, I believe, are the cause of much deception—may be considered.

The duties of the physician are relatively clear. First and foremost in American civilization comes his duty to the patient (there are, of course, exceptions in the case of minors). Second, he owes many duties to the State. This is more particularly true in the fields of public health, etc., and need not concern us here. Far to the rear of these concepts follow what other considerations there are.

If we admit the pre-eminence of the patient's health, we have simplified matters a great deal. We must simply ask ourselves and then carefully consider, "Will this patient's recovery and mental health be improved or retarded by knowing that he has cancer?"

These patients readily fall into two groups, those who may be curable and those who are not.

A specialist in cancer usually knows even after a cursory examination the site of origin of a neoplasm, and he knows or should know what percentage of these various types may be cured by radium, by x-ray, or by surgery. If he is at all honest he wishes to apply that therapy most likely to lead to a cure. All these instrumentalities are expensive and in many cases all three of them must be used. Almost every patient, without exception, is willing to sacrifice his material possessions if he can increase his chance of living as much as 1 per cent. Do we have the right to deny him not only the truth but also a full knowledge

of these other facts which may aid him to determine his course? There is only one answer—No!

But, you may say, the patient may take all this treatment without such suasion. Perhaps. How can one know in advance? If he "bucks" a little at some stage of the treatment and then you have to confess the truth, have you not lost his confidence?

But, the relatives plead, he may commit suicide. He will not! There are few who cling to life as do the cancer patients, if they, in fact, believe there is hope for cure. The danger of their losing this precious possession only increases the desire to cling to it, in early stages when they still possess full mental powers. They will worry, yes, but it is very doubtful whether that worry is more intense when the truth is known to them than it is in the cases of those pitiful individuals who suspect, but who are repeatedly assured to the contrary. The scales and the murmur at least are honest.

THE INCURABLE

Here the problem is more difficult. In the advanced case which is approaching a moribund state, the deception is not too important as regards the patient. Will Rogers, in his portrayal of "Old Doc Bull," speaks words of truth when he says something like this, "I have seen, I guess, three or four hundred people die, and none of them minded. They were too sick!" The critical faculties are blessedly anesthetized when this stage is reached. However, between these extremes there is a vast group of cases which tries the nerves and souls of all concerned—those patients whose neoplasms are slowly growing, but have metastasized or lie in inaccessible regions. Here, often the patients do fret and at times undergo mental agony. Yet is this agony any worse for those who know than for those who do not? Until finer means than we now possess are devised to measure quantitatively the mental states, we can have no certain answer. However, as one who has seen his share of these cases, I presume to conclude that in my own experience they do not.

¹For previous discussions of this subject see *RADIOLOGY*, December, 1934 23, 751, also February 1935 24, 247.

THE CONTRIBUTIONS TO RADIOLOGY OF PROFESSOR WILLIAM DUANE

By GEORGE L. CLARK, University of Illinois, *Urbana*

In the death on March 7, 1935, of Dr William Duane, Professor Emeritus of Biophysics at Harvard University, the science of radiology has lost possibly its greatest pioneer experimenter. As a physicist he played a leading rôle for twenty-five years in establishing the fundamental principles upon which the medical science of x-ray and radium therapy has been built. Without the products of his ingenious applications of physical laws of radiation to the scientific treatment of cancer, radiology would now be far less advanced. With the death of Professor Duane at the too-early age of 63, following several years of declining health, there were left uncompleted scores of further contributions in this, his beloved field of research.

William Duane, a direct descendant of Benjamin Franklin, was born in Philadelphia on February 17, 1872, and was graduated from the University of Pennsylvania in 1892. The following year he received a Bachelor of Arts degree at Harvard University and in 1895 a Master of Arts degree. As holder of the Tyn-dall fellowship of the University of Pennsylvania he studied in Germany at the Universities of Berlin and Goettingen and received the degree of Doctor of Philosophy from the former in 1897. He served then as Professor of Physics at the University of Colorado from 1898 to 1907, when he was invited by Pierre and Marie Curie to come to Paris and join them in radium research. He spent five great years in this laboratory. The impression which he created is illustrated by the following incident. On a visit to this country a few years ago Madame Curie was asked what places she would like most to see. Along with Niagara Falls she placed the laboratory of Professor Duane, at Harvard University, to which he came in 1913. In 1917 the chair of Biophysics was created by Harvard for him so that he could combine physics with applications in medicine and biology. He divided his time between the Jefferson Physical Laboratory and the Huntington Memorial Hospital under the direction of the Cancer Commission of the University, continuing immeasurably great work in both capacities until ill health forced him to retire in 1934.

The work of Dr Duane has been widely

recognized by presentation of honorary degrees, medals and prizes, and membership in great honorary societies in this country and abroad. One of the elements of a great personality, as always, was his great modesty and intense devotion to the highest ethics of science, which may have served to limit an even wider, though less enduring, acclaim. He was content to let his work speak for itself—and to those who know its value it shall remain through all time as a brilliant page in scientific achievement.

It is of interest to attempt to list a few of the outstanding contributions made by Professor Duane to radiology. The following list is by no means exhaustive but simply illustrative. Numerous radiologists will be surprised that many of the great fundamental principles employed daily as a matter of course in a rational modern use of radiation in the treatment of cancer, rest upon the original investigations of Professor Duane, who strove to remove all uncertainties and guesswork in the use of these rays.

- 1 Design and construction of a successful automatic apparatus for drawing off radon gas from a permanent radium supply into seeds for therapeutic use.

- 2 Design and first use in cancer therapy of a constant potential, high voltage, x-ray power plant utilizing high frequency (500 to 2,000) generators, condensers, etc.

- 3 Design and use of 100,000-volt storage battery at Harvard University in establishing laws upon the basis of absolutely constant voltage.

- 4 Improvement in design and first use of the ionization spectrometer less than a year after the original apparatus of the Braggs, leading to the long series of studies on x-ray wave lengths.

- 5 The first scientific study of general or "white" radiation, and the correlation of intensity with atomic number of the target element.

- 6 Discovery of the law of Duane and Hunt, that the short wave length limit (λ_0) of the general radiation spectrum is governed by the quantum law $Ve = h\nu_0 = hc/\lambda_0$.

- 7 The first accurate measurement from the above law of the value of the Planck action constant, h .

- 8 The first accurate evaluation of wave lengths in the *K* and *L* series of tungsten (used in all medical tubes as target) through as many as five orders of reflection. These 1914 values

Dr Max Cutler, Director of the Tumor Clinic of the above-named hospitals, gave the Editor the following facts upon the occasion of his visit

Michael Reese Tumor Clinic department was organized three and one-half years ago. At the present time, there is a full-time staff consisting of the following personnel: Director, first assistant, research assistant, resident and assistant resident, physicist (part time), four secretaries, nurse, three radium nurse-technicians, photographer, artist (part time). This makes fourteen full-time workers and two part-time workers.

The radium equipment consists of 500 milligrams of radium element in platinum needles and tubes. One radium pack holding four grams and one holding two grams. The total amount of radium available is six and one-half grams.

Recent developments in the department consist in the establishment of a laboratory of tumor pathology, a physics department, and an experimental research department.

The radium packs are utilized according to the Coutard principle. Patients who suffer from carcinoma of the mouth, tonsil, pharynx, larynx, or breast are treated twice daily and consecutively over periods varying between twenty and sixty days. The treatment is continued until the characteristic reactions of the skin and mucous membrane described by Regaud and Coutard are reached.

Carcinoma of the mucous membrane of the mouth, with the exception of the tongue and the cheek, are treated by a newly devised technique in which vulcanized moulds are fitted for each individual case. These moulds permit an absolutely accurate application which can extend over a period of days.

Carcinoma of the cervix is treated by means of the colpostat and a cervical applicator. Carcinoma of the breast is treated by a combination of surgery and radium. A selected group of operable carcinomas have been treated by interstitial radiation alone.

The bed capacity of the Edward Hines Hospital tumor division exceeds that of any other institution in this country or abroad. It now numbers approximately three hundred beds. Patients are sent to this unit from all the United States and referred to this unit by the other Veterans' Hospitals.

The manager is Dr Hugh Scott, who originally segregated the carcinoma patients from the other patients in the Hines Hospital and

recognized that they present a special problem in diagnosis and treatment. It is the present plan of the Medical Director, Dr Charles M. Griffith, to organize and equip several other subsidiary units for the treatment of tumors.

The Tumor Department is well equipped with x-rays and radium. The emanation plant contains one gram of radium. The radium bomb contains two grams of radium. This bomb was constructed with mercury protection instead of lead and is similar to the four-gram apparatus used in the Tumor Clinic of the Michael Reese Hospital.

There are two deep therapy x-ray machines, 200 K V each. X-ray therapy is administered according to the Coutard principle. The radium bomb is used principally in carcinoma of the larynx, pharynx, and tonsil by the divided dose method.

Radium emanation is used in the form of 0.3 mm gold seeds in the treatment of certain lesions. The seeds are inserted in removable steel needles so that the total filtration is equivalent approximately to 0.4 mm platinum.

The large bed capacity permits prolonged observation of patients during and after treatment.

A research unit has been installed by the Veterans' Bureau as part of the tumor division. This unit consists of an experimental research worker, a statistician, a photographer, and a secretary.

A comprehensive and efficient system of follow-up is enabled by this unit. Through the records in the central office of the Veterans' Bureau in Washington, the ultimate condition of every patient is known, so that the final follow-up is 100 per cent. This central control is of great assistance in this study of tumor cases.

INDIANA ROENTGEN SOCIETY

The eighth annual meeting of the Indiana Roentgen Society was held at the Indianapolis Athletic Club on February 22. Dr B. H. Nichols, of the Cleveland Clinic, Cleveland, Ohio, addressed the Society, and the following officers were elected:

President, D. C. McClelland, M.D., Lafayette; *President-elect*, E. M. Van Buskirk, M.D., Fort Wayne; *Vice-President*, P. D. Moore, M.D., Muncie; *Secretary-Treasurer*, J. N. Collins, M.D., Indianapolis.

the age of twenty-one had been attained by the, at that time, six-year-old boy

While the foregoing is only the logical result of an ordinary and not very unusual event, it is of sufficiently infrequent occurrence to cause us to "sit up and take notice," and should be another timely warning that "eternal vigilance is the price of liberty" The writer wonders how many who read this would have records of the length of time, the voltage, F S D or other important particulars of this exposure, *after sixteen years*

I S TROSTLER, M D

ITALIAN CONGRESS OF RADIOLOGY

The subject of the next Italian Congress of Radiology will be Diagnosis and Treatment of Pharyngo-esophageal Tumors, with Invasion of the Base of the Skull

In order not to miss any American contributions, the undersigned would appreciate reprints of any papers appearing in the United States on this subject

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BOOK REVIEWS

RADIOLOGIE CLINIQUE DU TUBE DIGESTIF
I—ESTOMAC ET DUODENUM By PIERRE DUVAL, JEAN CHARLES ROUX, and HENRI BÉCLÈRE In two volumes (I) The Stomach, (II) The Duodenum Second edition, quarto, 374 pages, 514 reproductions of roentgenograms, 516 drawings Cloth Published by Masson et Cie, Paris, 1935 Price 330 francs

Representing the joint efforts of an eminent surgeon, a distinguished gastro-enterologist, and the Nestor of French radiologists, this work could not fail to be a strikingly valuable contribution to the clinical radiology of the alimentary canal The general esteem accorded to it is shown by the fact that the first edition, published seven years ago, was sold out within eighteen months, and this alone would be sufficient reason for a second issue Aside from this consideration, however, the authors have rightly felt that a new edition is

warranted by advances in gastro-intestinal radiology in recent years Outstanding among such advances has been the intensified study of the mucosal relief, and in the present issue especial attention has been given to this feature Thus, as the publishers say, although the second edition is the same as the first, in conception and basis, it is also an entirely different work Primarily it is an unusually complete and systematic roentgenographic atlas, whose illustrations are clarified by accompanying drawings, but, in addition, each subject is formally discussed in concise but ample text.

Following a pictorial and textual presentation of the normal stomach with its variants, anomalies, and functional alterations, each of the diseases to which the viscus is subject is depicted and described A similar exposition of the duodenum and its diseases is given Facts and opinions concerning radiologic aspects of the various diseases are presented interestingly and clearly but without slavishly accepting all current hypotheses In this latter connection, American readers will derive keen entertainment from the sections dealing with gastritis and gastric syphilis Of gastritis, the authors say that no consistent radiologic expression can be claimed for it at this time, and that published descriptions have not been fortified with histologic proofs The authors assert that the gastric mucosa is incessantly mobile and has constantly changing aspects, and that the rugal pattern is conditioned by the position of the stomach, by its repose or activity, by the amount of opaque medium ingested, and by the degree of intra-gastric tension They say specifically that there is no relation between the radiologic appearance of the mucosal folds and their histologic structure or the gastroscopic picture which they present As to gastric syphilis, it is held that this multi-form disease has no pathognomonic radiologic expression, that the clinical diagnosis never rests on an indisputable basis, and that radiology is incapable of furnishing any information pertinent to an etiologic diagnosis of syphilitic lesions

Typographically attractive with its broad pages and excellent illustrations devoid of gloss, thorough in its coverage of radiologic gastro-duodenal diagnosis and cautiously conservative in its factual statements, the new edition will be warmly welcomed by radiologists and gastro enterologists all over the world

remain to this day very close to the present accepted values

9 The first quantitative study of critical absorption wave lengths from many elements, following soon after the discovery of the Moseley Law, and the first demonstration of departures from that law as a linear one

10 Proof of the identity in value of the characteristic ionization, characteristic absorption and the "quantum" wave lengths. The last is the value which must be excited in $Ve = hc/\lambda$, so that the emission lines will appear. These values were shown to be $1/4$ or $1/3$ per cent shorter than the value of the shortest characteristic emission line in a given series

11 The first quantitative measurements of the absorption coefficients for copper and aluminum, used as filters in x-ray therapy

$$\text{Al, } \mu/\rho = 15.5 \lambda^3 = 0.147$$

$$\text{Cu, } \mu/\rho = 193 \lambda^3 = 0.13$$

12 The original definition of "effective wave length" for a heterogeneous x-ray beam having the same absorption as some monochromatic ray, and the establishment of the standard absorption curves from which this is determined and defined for dosage

13 The first design and practical use in America of an air ionization chamber, standardized in terms of $e s u$, upon which in part is based modern intensity measurements in r units

14 The first therapeutic use of thorium and uranium target x-ray tubes

15 First measurements of x-ray spectra from aluminum target tubes

16 The discovery three years ago of characteristic emission lines shorter than $K\gamma$, due to O or conductivity electrons falling into the K energy level in the atom

17 The study of the general radiation spectrum from an extremely thin target (stream of mercury) and demonstration that a spectrum approaching a single wave length is produced

18 Numerous contributions to the knowledge of scattering of x-rays by containing walls, water phantoms, etc

19 Mathematical proof of transfer in quanta of radiation momentum to matter, as a preliminary step to development of modern wave mechanics

20 The first successful adaptation of Fourier series analysis of intensities and electron distributions following a suggestion by

Sir William Bragg, upon the basis of which great progress has been made in analysis from x-ray data of atomic, molecular, and crystalline structures

It is impossible to conclude this brief sketch without a personal note. The writer had the great privilege of working with Professor Duane for three years and came to know well not only the extraordinary scientific ability but the remarkable personality which left its indelible impress forever on the fortunate few who came into intimate contact with it. Quiet, modest, kindly, and considerate, he personified the ideal combination of man of science, home-lover, teacher, and friend. He derived his greatest joy in working on experiments with his students. His influence was radiated not so much in words, which were few, but in living and doing things just as well as it was humanly possible to do them. In appreciation of his inspiration and guidance which changed the course of a lifetime, this writer mentioned him in a phrase in the preface to a book on x-rays which somehow expresses the facts perfectly. Though he worked with invisible rays, and though the touch of a personality was invisible, William Duane was a Maker of Light.

HOW LONG ARE WE LIABLE?

PHYSICIAN SUED FOR ALLEGED FLUOROSCOPIC BURN AFTER SIXTEEN YEARS!

It has come to the writer's notice that a physician in a mid-western State has recently been sued for malpractice, *based upon surgical services rendered by him in 1918*

The defendant physician removed a needle from the leg of a six-year-old boy sixteen years ago, and the plaintiff now alleges that a roentgen dermatitis resulting from the use of the fluoroscope, while searching for the needle, during the operation, permanently and seriously damaged him

The statute of limitation for this sort of action places two years as the period within which suit may be brought, in the State wherein this suit is pending, but because the plaintiff in this case was a minor at the time of the alleged injury, the statute of limitation did not begin to run (or, as the legal profession say, was *tolled*) until he, the plaintiff, became of age. Consequently, the limitation as prescribed by the statute, did not expire until two years after

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S M ATKINS, M D, of Waterbury, Connecticut	DAVIS H PARDOLL, M D, of Chicago
J E HABBE, M D, of Milwaukee, Wisconsin	E A POHLE, M D, Ph D, of Madison, Wisconsin
H W HEFKE M D of Milwaukee, Wisconsin	W H SODEMAN, M D, of New Orleans
CHARLES G SUTHERLAND, M D, of Rochester, Minn	

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UNTERSUCHUNGEN ÜBER DIE MÖGLICHKEITEN EINER DREIDIMENSIONALEN RÖNTGENOGRAPHISCHEN ABGRENZUNG INNERER ORGANE DES MENSCHLICHEN KÖRPERS (Investigations Concerning the Possibility of Outlining Inner Organs of the Human Body Roentgenographically in Three Dimensions) By CARL WEGELIUS, of Helsingfors, Finland A volume of 148 pages, with 115 illustrations Published by Mercators Tryckeri Aktiebolag, Helsingfors, 1934 Price, not given

The author has undertaken extensive studies in an attempt to outline radiographically the inner organs, as, for instance, the heart in three dimensions After a thorough analysis of the underlying theory he describes the construction of a rather complicated looking apparatus which permits the roentgen examination of patients in three dimensions Numerous illustrations show the results obtained by this method The assumption is made that the organs are of convex contour, and anatomic as well as physiologic facts seem to bear this out How much more information can be gained by the author's method, and if this gain will warrant the acquisition of the special apparatus needed for this procedure, is difficult to say The monograph is well illustrated, it also offers a short bibliography

DIE RÖNTGENSPEKTROGRAPHIE ALS UNTERSUCHUNGSMETHODE BEI HOCHMOLEKULAREN SUBSTANZEN, BEI KOLLOIDEN UND BEI TIERISCHEN UND PFLANZLICHEN GEWEBEN (Roentgenspectrography as a Method of Studying High Molecular Substances, Colloids, Animal and Vegetable Tissue) By Dr J R KATZ, of Amsterdam A volume of 333 pages, with 187 illustrations Pub-

lished by Urban & Schwarzenberg, Berlin, 1934 Price, Rm 20, 22 (geh and geb)

In the introduction the author states that there is no suitable book available, at least not simple enough for the purpose of the biologist and colloid chemist, which describes the roentgenspectroscopy of high molecular and colloid substances According to his experience the following four problems can successfully be studied by this method Is the substance crystalline or amorph? What is the nature of the reflecting grating? How are the elements arranged which act as grating? How large are the parts of crystals if they are too small to be measured microscopically?

After a detailed description of the technical procedure, the results obtained by roentgenspectrography in the various groups of high molecular substances are related Among the substances discussed are proteins, cellulose and its various compounds, starch, and rubber The low molecular colloids are dealt with in a separate chapter Of interest to the physician is the x-ray analysis of tissue—muscle, nervous tissue, connective tissue, and hair were studied by the author Those who attended the meeting of the Radiological Society of North America, in 1930, in Los Angeles, will undoubtedly recall a preliminary report on the same subject by Clark, of the University of Illinois

In a concluding chapter the author offers valuable advice to the beginner in carrying out certain roentgenspectrographic examinations He likewise includes instructions in the preparation of roentgen spectra suitable for publication The book is well illustrated and, since difficult mathematical formulæ are avoided, it does not require a special training in physics to read and understand its contents

THE APPENDIX

The Solution of the Roentgen Diagnostic Problem in Chronic Appendicitis Conclusions Based upon Studies Covering a Period of Twenty Years and Including a Comparative Analysis of Roentgenological, Clinical, Surgical, and Postmortem Findings Thomas Scholz *Am Jour Roentgenol and Rad Ther*, June, 1934, 31, 792-814

Eliminating from consideration the acute appendix, the author states that roentgenology should be useful in determining appendiceal pathology because of ability by this method to determine the location, either by direct or indirect visualization of this structure. The writer has made painstaking observations, in a large number of individuals, not only of their gastrointestinal roentgen findings but also of the gross and microscopic appearances of the removed appendices, and also of the subsequent clinical condition of the appendectomized individuals, for a sufficiently long period of time after surgery was performed to determine the clinical results. He points out that both microscopic and macroscopic changes of all degrees are frequently found in clinically normal individuals, and that, therefore, abnormal pathologic findings by no means indicate a connection between clinical symptoms and the appendix. He emphasizes the point that "clinical cure" is the only satisfactory basis for determining the wisdom and effectiveness of appendectomy in the individual with a chronic abdominal complaint. On this basis he discards all so-called abnormal x-ray findings such as fixation, stasis, kinking, and spasm, and retains only the one finding of localized tenderness to palpation immediately over the barium-containing appendix as a reliable roentgenologic sign of clinical pathology. Radiographic findings are of value, therefore, merely as an aid to the surgeon in planning the operative procedure.

J E HABBE, M D

ARTHRITIS

The Orthopedic and Physical Therapeutic Treatment of Chronic Arthritis Loring T Swann *Jour Am Med Assn*, Nov 24 1934, 103, 1589-1592

There are four objectives in the treatment of chronic arthritis (1) to control and stop the disease, (2) to prevent deformity during the course of the disease, (3) to restore the patient to normal life as functionally capable as possible, and (4) to prevent recurrence of the disease. The orthopedist can materially aid in the success of medical treatment by securing the best use of the body through training. Faulty posture prevents normal physiologic activities and development of resistance and may retard recovery.

Arthritis is a constitutional disease. The circulation is out of order, vasomotor control is unstable, the basal metabolism rate is often subnormal, the blood pressure is low, the function of the gastro-intestinal tract is below par, there is always secondary anemia. Much of this the author attributes to disturbed physiologic functioning from faulty posture.

To prevent deformity one must anticipate the occurrence of flexion by light plaster splinting. Rest is secured, with the relief of strain and irritation. Protection at night is more important than during the day. The tendency to ankylosis must be avoided by early minimal exercise and gradual shortening of the time of rest, splints should not be left on too long. The correction of deformity and restoration of joints to normal function as far as possible are secured by rest and splinting, as above described, by corrective splinting, by manipulation of joints under an anesthetic in quiescent cases, and by open operation. Physical therapy should precede operative procedures to improve local and general circulation, to relax and develop muscles. Heat, massage, and exercise are discussed in detail.

CHARLES G SUTHERLAND, M D

The Medical Treatment of Chronic Arthritis Russell L Cecil *Jour Am Med Assn*, Nov 24, 1934, 103, 1583-1589

Osteoarthritis, or hypertrophic arthritis, is a degenerative process which affects the bone and cartilage, a senescent process similar to arteriosclerosis or gray hair. The Germans and French speak of this condition as an "osteo arthrosis," indicating that it is not inflammatory in nature. It is characterized by some enlargement of the ends of the bones and by an absence of soft tissue swelling. Ankylosis does not occur in this form of arthritis.

Rheumatoid arthritis, or chronic infectious arthritis, is a chronic progressive inflammatory disease, characterized in its early stages by migratory pain and swelling in various joints and in the later stages by ankylosis and deformity. In its incipient stage it is purely synovial. Hypertrophic arthritis is present in almost 100 per cent of elderly patients, trauma referable to overweight (in weight-bearing joints), occupation, bad posture and deformities are etiologic factors. In menopausal or climacteric arthritis the patient (usually overweight), is treated by reduction of weight and restoration of basal metabolism rate, if low. Cessation of over-activity of the joint by lessening exercises is also recommended. Heat in all its forms is extremely valuable, and intestinal elimination. In the treatment of rheumatoid arthritis the elimination of trauma and the stimulation of the local circulation are the important factors.

The therapy of this disease is discussed in detail in four groups (1) mild early cases, (2) active febrile cases, (3) well established chronic cases, and (4) advanced bedridden cases.

CHARLES G SUTHERLAND, M D

The Treatment of Chronic Arthritis General Principles Ernest E Irons *Jour Am Med Assn*, Nov 24, 1934, 103, 1579-1583

Chronic arthritis offers a major challenge to the medical profession and the public. It can no longer be thought of as a disease of certain joints but, rather, as a systemic illness, in which there may be disturbances of

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arthrosis is present in both bones, with a characteristic angular deformity of the lower third of the leg. The proximal bone ends are pointed and sclerosed in older cases, the distal fragments are frequently cup-shaped, with a varying degree of definite absorption between the bone ends.

There is considerable divergence of opinion regarding the etiology, however, a congenital embryonal defect is favored by the majority. The deformity is present at birth and fractures occur either at or shortly after birth, hardly ever healing spontaneously.

Operative treatment is not indicated under the age of eight.

CHARLES G SUTHERLAND, M D

Os Acetabuli Eugene Freedman *Am Jour Roentgenol and Rad Ther*, April, 1934, 31, 492-495

The os acetabuli is a normal epiphyseal bone situated in the Y shaped cartilage which appears at the age of fourteen and usually unites with the rest of the acetabulum at the age of eighteen. It is bilateral and is either a single or a multiple ossification center, the roentgen visualization of which depends upon its location. If it is situated in the midportion of the acetabulum, the overlapping head of the femur obscures it. If it grows laterally its outlines can be clearly distinguished. At times, one of the bones unites earlier than the other, in which case the non-united bone can be mistaken for a fracture of the acetabulum.

The persistent os acetabuli occurs most often bilaterally, but occasionally unilaterally in individuals older than eighteen years of age. It indicates a failure of union, probably due to internal secretory disturbance. It does not represent a pathologic process.

If an irregularly defined structure resembling the os acetabuli is seen unilaterally in an older individual a trauma, a tuberculous or an osteomyelitic sequestrum must be considered.

S M ATKINS M D

CANCER (THERAPY)

Simultaneous Radium and Roentgen Therapy of Carcinoma of the Breast Franz Melchart and Wilhelm Schloss *Strahlentherapie*, 1935, 52, 20-30

During the last three years the authors treated carcinoma of the breast of all stages with a combination of radium needles and x rays, or radium needles and telerradium therapy. Technique: Needles of various lengths depending on the size of the tumor, are inserted at a distance of 1 centimeter. They remain 100 hours in the tissue so that per cubic centimeter of tissue there is 1 mcd (133 mg hr). This implantation is usually done under local anesthesia. Half an hour after the implantation x ray therapy is started (178 K.V. 50 cm FSD 0.5 mm Cu + 1 mm Al or Thoracuss filter 8 to 17 r per minute 200 to 250 r per field per day). The total dose over the breast amounted to from 2,500 to 3,000 r over the supraclavicular area, from 1,500 to 2,000 r over the axilla from 1,000 to 1,500 r. Two fields were given daily. A few roentgenograms are appended showing the radium needles *in situ*.

Thirty case histories are appended. 23 of these patients received radium implantation plus x ray therapy, nine died, eight are free from symptoms up to two years and three months following the treatment, five were improved, and one had to be operated on. Seven patients were treated by a combination of radium needles and telerradium therapy. One patient lived two years and three months following the treatment, three cases were improved and free from symptoms for two, nine, and fourteen months, respectively, three cases were cured and have been observed for 11, 30 and 30 months, respectively. The authors feel that there are several advantages to this method. The radium and x ray reactions appear at the same time and the tumor receives a maximum dose without more damage to the skin.

ERNST A POHLE, M D, Ph D

Data Concerning Three Years Experience with 600 K V (Peak) Roentgen Therapy Seeley G Mudd, Clyde K Emery, Orville N Meland and William E Costolow *Am Jour Roentgenol and Rad Ther*, April, 1934, 31, 520-531

At the California Institute of Technology, during the past three years, 285 cancer patients have been given roentgen therapy with 600 K V. Only inoperable cases are accepted, a large majority showing regional lymph node metastases, but still being in fairly good general condition. Biopsy is required, the tumors being graded according to Broders' classification. Within the treatment room the tube which is 30 feet long, is surrounded by a 2 inch thickness of lead armor. Four patients are usually treated simultaneously, the output of the tube being constantly measured in roentgen units. The effective wave length at 600 K V, using 5-mm steel filter and 70 cm target skin distance, is 0.04 Å. and the output 15 r per minute.

Moderately heavy protracted irradiation using multiple portals is the method used, 300 r being administered daily per field, and each field getting from 900 r to 1,500 r per series. Rest periods are usually four to six weeks in length and several cycles are usually administered. The skin tolerance is about 1,200 r per field.

Many instances of palliation in patients able to withstand full cycles of high voltage roentgen therapy have been observed, the results achieved comparing favorably with the effects produced by the 4-gram radium pack.

J E HABBE, M D

Roentgen Therapy of Carcinoma of the Fundus Uteri and of Post menopausal Metrorrhagia P Gibert and L Solomon *Strahlentherapie* 1935, 52, 31-36

The Successful Radiation Therapy of Adenocarcinoma of Fundus Uteri H Wintz *Strahlentherapie*, 1935, 52, 37

While a number of gynecologists, for instance Seitz and Wintz, report excellent results in roentgen therapy

the circulation, the general metabolism and nutrition, and the gastro intestinal system, as well as local changes in the joints. Very early the only objective demonstrable disturbances may be in one or more joints. The immediate cause may be infection or trauma, which, however, becomes effective in producing serious disability because of the intrinsic qualities of the tissues of the patient. This broader view of the nature and causes of arthritis is rapidly gaining ground. The suffering and disability entailed by chronic arthritis exceed those from any other of the chronic diseases of temperate climes. The mortality of chronic rheumatism is low but the suffering and disability are enormous.

Acute rheumatism was early separated clinically from chronic rheumatism and soon became distinguished as acute rheumatic fever, likewise, gout was similarly set apart clinically. The arthropathies of neurogenic origin were recognized, and still later the identification of infections due to specific organisms allowed the separation of acute and chronic arthritis associated with these infections. There was then left the large group of cases of chronic arthritis, which Garrod, in 1890, divided clinically into rheumatoid arthritis and osteo-arthritis. The view was frequently expressed then and in succeeding decades that rheumatoid arthritis was more than a disturbance of joints and depended on underlying constitutional disturbances.

The American Committee for the Study and Control of Rheumatic Diseases divided chronic arthritis into (1) chronic atrophic rheumatoid arthritis and (2) chronic hypertrophic arthritis, osteo-arthritis. In the former the incidence is chiefly in younger persons of ptotic habit, especially women. The onset may be insidious or acute, associated with infection, and a hereditary element is clearly evident at times. There is multiple joint involvement with fusiform appearance of the hands, often ulnar deflection, and later ankyloses. In many patients constitutional effects, with slight fever, anemia, and poor nutrition are evident. Periods of spontaneous remission are a feature, improvement may last for months. Hypertrophic or osteo arthritis usually is seen in persons at or beyond middle life, often well nourished and it produces disability varying from slight to severe crippling. It is usually polyarticular but may be monoarticular. Lipping of joints and hyperostoses are frequent, ankylosis is rare. Fibrous thickenings Heberden's nodes, with later bony hyperplasia at the terminal joints of the fingers, are frequent. The effects of trauma and work are often noted in the hands and spine of the laborer.

The committee of the British Medical Association subdivides the rheumatoid and osteo-arthritis into groups with or without infection and adds chronic villous arthritis and spondylitis, the latter being subdivided into (a) ankylopoietica and (b) osteoarthritica. There are borderline cases which it is difficult to place in one or the other group. Pathologic tissue changes characteristic of each group are found in the same patient, and roentgen films may show findings suggestive of atrophic and hypertrophic arthritis in the same patient. The kind of trauma and the location of the

joint seem to determine, in part, the reaction that occurs. The time of life when damage occurs and the kind of reaction to injury exhibited by the tissues of the individual are factors. Treatment must be highly individualized to meet the requirements of each patient.

CHARLES G. SUTHERLAND, M.D.

BIOLOGIC EFFECTS

The Present Status of Roentgen Therapy with Voltages Above 200 K V. Technical Development and Medical Application. T. Leucutia and K. E. Corrigan. *Am Jour Roentgenol and Rad Ther* May, 1934, 31, 628-662.

The writers discuss the subject from the point of view of technical development as well as of the physical biological, and clinical application of the radiation produced. Clinically it has been determined that, with the higher voltages above 200 K V, with appropriate filtration, two advantages in the treatment of malignant disease are obtained: these being larger amounts of radiation to the tumor and more uniform irradiation. Tumors in the oral cavity, pharynx or larynx, neck, and pelvic organs which could not be controlled satisfactorily by 200 K V radiation responded well to from 400 to 500 K V equivalent. Mixed radiation is believed at times to offer decided advantages over radiation of a single quality. It is pointed out that there is still uncertainty as to the influence the quality of radiation plays upon the biologic response, some believing that equal numbers of roentgens regardless of quality, produce equal effects, others stating that the energy absorbed is the responsible factor, and still others holding that there is a direct dependence on the quality factor. It is obvious that many phases of the nature and action of radiations must await further investigation.

J. E. HABBE, M.D.

BONE DISEASE (DIAGNOSIS)

Congenital Pseudarthrosis of the Leg. Three Cases Treated by Massive Bone Graft. Paul C. Colonna. *Jour Am Med Assn*, Dec 29 1934 103, 2012-2016.

This is not merely a fracture that fails to unite but a pathologic condition in the bone or bones causing weakness and subsequent fracture. The bones of the leg are by far the most frequent site of the lesion: the clavicle, ulna, and femur may be involved.

The roentgenographic appearance of the bones in early cases of this disease before fracture has occurred presents a typical and characteristic picture. Areas or an area, of rarefied bone, commence in the region of the periosteum and extend partly or completely throughout the whole diameter of the bone in the region of its lower third. It suggests a local osteitis fibrosa cystica and a certain amount of movement may be obtained in the bone at this point even in the absence of a fracture due to the impairment of the bone. Cases with incomplete fracture which have been reported showed very slow union and there was no obvious callus. The type commonly seen is one in which a frank pseudo-

cases of carcinoma of the pharynx 55 of these were living at the end of the first year, 30 at the end of the second, 14 at the end of the third, 14 at the end of the fourth, 11 at the end of the fifth, 10 at the end of the sixth, and 8 (9 per cent) at the end of the seventh year. The treatment was carried out with the well known protracted fractional dose method and from 6,000 to 8,000 r were applied to the skin. The average field size was from 75 to 125 sq cm, the tube potential 200 K V, with 2 mm Zn + 3 mm Al as filter. The F S D varied from 40 to 60 centimeters. In each case the treatment was carried up to the point of marked skin and mucous membrane reaction.

An analysis of the cases showed that all epitheliomas which remained cured had not infiltrated the surrounding tissue. An increase in the dose was usually of no benefit and sometimes injurious. A prolongation of the treatment time obviously improved the results. It varied for the various types of carcinoma from 25 to 60 days. The degree of reaction seemed to be mostly influenced by the growth characteristics of the cancer and not by the applied dose or any individual variations in susceptibility. The time factor was of little influence in the treatment of non-infiltrating carcinoma, but seemed to be of decisive influence in the irradiation of infiltrating carcinoma. Brief case histories of two patients are appended. There are also lateral roentgenograms of the larynx of each patient before and after radiation therapy.

ERNST A. POHLE, M D, Ph D

DOSAGE

Roentgen ray Standards and Units. Standardizing Procedure of the National Laboratories. *Am Jour Roentgenol and Rad Ther*, June 1934, 31, 815-818.

This is a brief article presenting standardization efforts by the National Bureau of Standards (United States of America), National Physical Laboratory (Great Britain), Physikalisch Technische Reichsanstalt (Germany), and Service d'Etalonnage de l'Hôpital St Antoine (France). Heterogeneous roentgen rays are classified as follows: 'ultra soft' (Grenz) radiation with a range of from 5 to 20 K V P applied potential, with an equivalent 'end radiation' limits of from 2.5 to 0.6 Ångström units, 'soft' radiation ranging from 20 to 120 K V P, with end radiation limits of from 0.6 to 0.1 Ångström, 'hard' radiation ranging from 120 to 250 K V P, with end radiation limits of from 0.1 to 0.05 Ångström and 'extra hard' radiation ranging from 250 K V P upward, with end radiation limits less than 0.05 Ångström. The article considers measurements of quality, measurement of the roentgen and calibration of dosimeters.

J E HABBE, M D

Variations in Dosage Dependent on Wave Length. M C Reinhard. *Am Jour Roentgenol and Rad Ther*, April, 1934, 31, 538-540.

According to the writer, radiation dosage is approximately inversely proportional to the absorption or,

in other words, the more penetrating the beam the less is the absorption per unit volume and the greater is the amount of radiation which may be administered before reaching, for example, the skin tolerance. A curve showing the relation between wave length and mass absorption coefficient for water is constructed, also curves for determining the skin erythema dose in roentgen units from the effective wave length, and for determining the relation of effective wave length to half value layer measured in copper and aluminum.

J E HABBE, M D

ENCEPHALOGRAPHY

Encephalography under Nitrous Oxide Anesthesia. R W Waggoner and L E Himler. *Am Jour Roentgenol and Rad Ther*, June, 1934, 31, 784-786.

The writers recommend nitrous oxide anesthesia in preference to ether or sodium ethyl barbiturate as a safe means, without any attendant undesirable features, for minimizing the discomfort during and following encephalographic examinations. Patients ranging in age from two to fifty-six years have been examined with the aid of nitrous oxide, and no unfavorable changes in pulse, blood pressure, respirations, or cell counts were recorded which might not also have occurred without any anesthetic being administered.

J E HABBE, M D

ESOPHAGUS (DIAGNOSIS)

Disturbed Peristalsis of the Esophagus, with Formation of Pseudo-diverticula. J Palugyay and G Pesek. *Röntgenpraxis* July, 1934, 6, 417-420.

Cases of so-called functional (Bársony) or false diverticula (Gregoire) of the esophagus have been described occasionally. The case reported by the authors showed on fluoroscopic examination, multiple constrictions and sac-like pseudo-diverticula in the lower third of the esophagus. They appeared for a few seconds only after swallowing and disappeared after the peristalsis stopped, the esophagus then presented a very normal appearance. The patient complained little of esophageal symptoms. An examination ten months afterward showed the same picture and administration of belladonna did not change the spasm and sac-like deformities. The appearance and disappearance of the so-called diverticula were always in direct connection with the peristalsis.

Because the false diverticula are always seen in the same areas of the esophagus, the authors believe that there must be an organic change in the wall of the esophagus which disturbs the normal course of the peristaltic waves.

HANS W HEFKE, M D

EXPERIMENTAL STUDIES

The Influence of Roentgen Irradiation on the Blood Sugar of Rabbits and Their Suitability for Blood Sugar Experiments. J Engelbreth-Holm. *Strahlentherapie*, 1935, 52, 101-114.

The author has carried out extensive blood sugar

of carcinoma of the corpus uteri, Gibert and Solomon have not been able to duplicate their results. Although they used a radiation of 200 K.V. filtered through 0.5 mm Cu or 1 mm Zn + 2 mm Al, four to six fields of entry, 2,000 to 3,000 r per field, the percentage of cures amounted to only 16.6 as compared with the results of Wintz (69.4 per cent in operable and 9.2 per cent in inoperable cases). The authors feel that the explanation lies perhaps in the fact that many physicians still believe that any post menopausal bleeding is due to carcinoma while careful histologic studies have shown that only 60 per cent of these patients have a malignancy. Unless there is a definite microscopic diagnosis of carcinoma irradiated cases should not be accepted for statistical evaluation. The authors conclude that in their experience roentgen therapy alone has never cured intra uterine carcinoma. Even the palliative results were only moderate.

In the following article Wintz offers his rebuttal to this article of the two French radiologists. He relates his own experience with roentgen therapy in carcinoma of the corpus uteri which is based on the treatment of 171 cases. Seventy three of these or 42.7 per cent were well five years after the treatment. From 1916 to 1928, 95 operable cases were irradiated of which 69.4 per cent remained well after five years. During the period 1915-1928, 76 inoperable cases were irradiated of which 9.2 per cent were cured. Every one of these cases was microscopically proved to be carcinoma. In addition to that, he offers a most convincing group of 22 patients who have survived the radiation therapy for more than ten years. Two women lived 17 years, one, 16 years, three 15 years, three 14 years, two, 12 years, three 11 years, and two, 10 years following the treatment. The case histories of 16 patients are abstracted. In 13 of these, photomicrograms of the biopsies are shown in the article. According to the material presented by Wintz, there seems to be little doubt that carcinoma of the fundus uteri can be cured by radiation therapy. In closing he discusses the difference in technic as used by Gibert and Solomon and by himself. He feels that therein is in all probability the explanation for the poor results obtained by the French radiologists.

ERNST A. POHLE, M.D., Ph.D.

The Value of Irradiation in the Treatment of Ovarian Carcinoma. John H. Harris and Franklin L. Payne. *Am Jour Obstet and Gynecol*, January, 1935, 29, 88-92.

These authors present 38 cases of ovarian carcinoma treated by roentgen rays. Results confirm those of a similar series reported by Keene, Pancoast, and Pendergrass who concluded that it is impossible to predict the effect of irradiation in any given patient. That in generalized carcinomatosis without removal of the primary growth little can be expected from treatment and that with removal of the primary growth outlook for relief of symptoms is more hopeful. Harris and Payne add to these conclusions a better prognosis for palliation and for prolongation of life due to improvement of technic.

The histologic type of carcinoma is of no value in determining what the effects of roentgen therapy will be.

Cases are grouped according to extension of the growth and compared with a group of 51 similar cases treated by operation alone. While the groups are too small for statistical analysis, results show a distinctly beneficial effect with irradiation both in prolongation of life and in relief of symptoms.

The technic of treatment is outlined.

W. A. SODEMAN, M.D.

The Histological Classification of Cancers of the Uterine Cervix and the Relation between the Growth Structure and the Results of Radium Treatment. H. Chambers. *Am Jour Cancer*, January, 1935, 23, 1-15.

Chambers has analyzed 500 cases of cancer of the cervix to determine the relationship between their structure and the results of radium therapy. The method of grading, an inherently difficult problem, is based on the extent of differentiation and degree of cell activity, with a consideration of the general architecture of the growth as well. Squamous-cell types are divided into four grades. Grade I includes all typical cases of the adult common type of squamous carcinoma, Grade II, the types composed of the spindle cells, Grade III consists of all cases in which there is a clear tendency to form stratified epithelium with subgrouping according to extent of differentiation, Grade IV includes all anaplastic growths showing no formation of stratified epithelium. Treatment used is the technic of Forssell modified to improve the distribution of the radium. No modifications were made for various histologic types.

The highest percentage of local cures, 73.8 per cent, was obtained in the squamous group, Grade III, transitional type. In adenocarcinoma no evidence of insensitivity to radiation was obtained, local cures occurring in 72.9 per cent of the cases. None of the histologic grades showed a difference of more than 15 per cent in either local cures or in the number of three year survivors.

W. A. SODEMAN, M.D.

Hyperintensive Irradiation of Certain Types of Carcinoma. Preliminary Report. H. Lammers. *Strahlentherapie* 1935, 52, 51-60.

The author has treated a number of cases of advanced carcinoma of the breast with a multiple field method. Technic: 200 K.V. 0.5 mm Cu 16 cm F.S.D., 18 r/min dose per area 1,200 r. The advantages of this procedure are the short treatment time, the relatively high doses, and the absence of pleura and lung injuries. In a future publication results obtained in earlier cases of carcinoma of the breast will be reported. Six case histories are appended.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Therapy of Carcinoma of the Pharynx. H. Coutard. *Strahlentherapie*, 1935, 52, 1-10.
During the period 1921-1926 the author treated 89

Excessive mobility was arbitrarily diagnosed when the vertical excursion reached 3 inches for the hepatic flexure and 2.5 inches for the cecum, and excessive fixation when the vertical range in mobility resulting from change in posture was one inch or less. Excessive mobility was present in 10.4 per cent, of which 60 per cent were females and four times as many in sthenics as in asthenics. High cecal incidence was over twice as great as normal in the hepatic flexure mobility cases, and in the incidence of hepatic flexure mobility was slightly higher than normal in the high cecal cases. Low cecal cases in the hepatic flexure mobility series were slightly below normal figures.

Excessive mobility of the cecum was exactly that of the hepatic flexure, males were 52.5 per cent. Sthenics show striking predominance over asthenics, 55 per cent of the former and 7.5 per cent of the latter. With this mobility the incidence of high cecum was great. Excessive mobility of both hepatic flexure and cecum was rare.

Excessive fixation of the hepatic flexure occurred in 27.9 per cent with 60.7 per cent for males, with habitus not of significance. Excessive fixation of the cecum was present in 43.3 per cent with asthenics slightly predominating. Excessive fixation of both cecum and hepatic flexure was 19.8 per cent.

The clinical significance of excessive mobility of the hepatic flexure or cecum seems practically *nil*, however, in cases of non-fixation of the cecocolon there can occur such conditions as volvulus of it, ileocecal intussusception, or prolapse of the cecum through a hernia. Headaches, vomiting, right sided pain or tenderness, constipation, and cecal stasis were not increased. Colitis was slightly more in cecal hypermobility, and gall-bladder disease was found twice as often as in the normal and four times as often as in the fixed hepatic flexures.

As to the clinical significance of excessive fixation, hepatic flexure fixation is more intimately connected with colonic irritability than with colonic stasis. Gall-bladder disease is less frequent than in the normal and excessively mobile. Headaches and vomiting as well as pain and tenderness are not affected.

These cases are not surgical but, rather, medical, except the patients with acute volvulus or intussusception.

S. M. ATKINS, M. D.

The Syndrome of Hypertonic and Atonic Colopathy
Fred H. Kruse Jour. Am. Med. Assn., Nov. 3, 1934,
103, 1366-1370

The author suggests limitation of the term "colitis" to inflammatory states of the large bowel. These inflammations from simple catarrhal to chronic ulcerative colitis as well as related conditions producing definite pathologic lesions, have been well demonstrated and their causative agents have been determined. These range from chemical poisons, certain deficiency states as noted in pellagra and sprue, protozoan infestations and above all bacterial infections. The chronic colopathies characterized by constipation and intermittent

diarrhea, represent by far the greater proportion of chronic bowel disorders that occur without any evidence of definite pathologic lesions of the mucous membranes. The cause of this condition has been assigned, on the one hand, to constitutional and functional origin, and, on the other, to local irritative lesions or more general metabolic disorders.

Students of the more chronic colopathies recognize a probable congenito functional origin, since the causes of chief influence are partly congenital but inherently functional, and are manifested by certain psychic and anatomic disturbances of the nervous system.

It is the inco-ordination of muscular motor function rather than its paralysis or absence that is at the base of all constipation, except in the definitely mechanical obstructive types.

There is a uniform tendency for hypertonicity to be more apparent in shorter and more normal forms, whereas atonic loops and states appear more frequently as the bowel becomes more redundant.

The main factors involved are the relative activity at various periods of the parasympathetic and sympathetic divisions of the autonomic nervous system. The parasympathetic (craniosacral) notably the vagus, is the activator, carrying fibers that increase secretion, produce spasticity and motor activity, and, if overstimulated, cause the excessive formation of mucus and lead to colic and hyper irritability. The sympathetic system (with its paravertebral ganglions) is the inhibitor or depressor, the direct antagonist of the parasympathetic. Stimulation or activity of this system leads to relaxation and loss of tone and to checking of secretion.

The hypertonic colopathies include the spastic colon, the irritable colon and mucous colitis. A preponderance of evidence indicates that the syndrome of the spastic irritable colon is a visceral neurosis (in some respects akin to asthma), and exists only in persons with unstable or poorly co-ordinated nervous systems.

Nature has provided for retention or favorable stagnation in the normal cecum. When the fluid contents are projected rapidly to the distal colon, irritation, fermentation, impaired absorption of intestinal gases, colonic spasm and pain, and systemic toxic effects result. On the other hand, when the contents of the proximal colon are held too long, the dry inspissated residue produces a similar result, though with different characteristics. In functional colon disturbance are found (a) spasm, most pronounced in the descending and sigmoid colon, (b) peristalsis and antiperistalsis, greatly increased in the cecum and adjacent bowel, with prolonged stasis, and (c) excessive mucous secretion. An underlying neurosis is the essential factor that produces this type of habitual constipation and irritable colon.

The stools show great variation in form and shape ranging from naturally formed to mushy or watery, or with alternating periods of small dry, marble like masses, followed by diarrhetic looseness and great quantities of mucus. They are essentially negative on microscopic examination although occasionally a few

studies on rabbits under various conditions in order to determine their suitability for experimental purposes. She comes to the conclusion that, in view of the instability of the blood sugar level in rabbits, they are not suitable for experiments in cases in which changes of the blood sugar are to be used as the indicator.

ERNST A. POHLE, M.D., Ph.D.

THE EYE

A Simple Technic for the Radiography of the Optic Canals Cesare Fava Arch di Radiol, 1934, 10, Pt 1, 364-369

Fava lays the patient with his forehead on the Potter-Bucky diaphragm in the usual position for sagittal exposure of the skull. The external occipital protuberance and the apex of the mastoid are marked and the head is rotated until these two points come into line. The x-ray tube is placed at a meter distance centering on Busi's point. The author shows some radiographs taken by this technic.

E. T. LEDDY, M.D.

FOREIGN BODIES

A Method of Roentgen Localization of Foreign Bodies in the Stomach Prior to Gastroscopic Removal Gabriel Tucker Jour Am Med Assn Nov 10 1934 103, 1440, 1441

In a recent case in which there was supposed to be a piece of wire in the stomach it was desired to localize it definitely and at the same time to show its relation to the cardiac end of the stomach and the hiatal esophagus. In order to do this the patient swallowed a rubber tube, which passed through the hiatal esophagus and cardiac coiling itself around the greater curvature of the stomach, giving its relation to the foreign body in the antero-posterior and lateral planes. The tube was used to empty the stomach before gastroscopy.

If desired, air could be insufflated into the stomach through the tube before its withdrawal.

CHARLES G. SUTHERLAND, M.D.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Some Studies on the Mechanism of Rapid Cholecystography Antonio Capua Arch di Radiol. 1934, 10, Pt 1, 370-376

The author studied the time of the appearance of the cholecystogram after injecting substances which stimulate secretion of bile. The cholecystogram appeared slightly earlier than with the usual endovenous method of Graham. He, therefore, feels that bile stimulating substances have only a secondary effect in the production of the cholecystogram.

E. T. LEDDY, M.D.

Diverticulum of the Gall Bladder Jacob H. Vastine Am Jour Roentgenol and Rad Ther May 1934, 31, 603-606

Diverticula of the gall bladder are not an uncommon finding at operation or autopsy. Their etiology is uncertain but it may be pulsion, traction, or congenital. Two cases are reported which were diagnosed by cholecystography. In one there was a positive shadow adjacent to the filled gall bladder characteristic of a gallstone (1 cm. in diameter), and the fundus adjacent to it was indented. The second showed a separate shadow (1 cm. in diameter) adjacent to the gall bladder. These must be differentiated from congenital malformations as double gall bladder, hour glass gall bladder, redundant gall bladder, and pericholecystic adhesions. The differentiation should be made easier by films taken at different angles. Films made after a fat meal showed the decrease in size of the diverticulum less than the gall bladder, due to the absence of muscle fibers in the wall of the diverticulum.

S. M. ATKINS, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Colon Studies VII Variations in Fixation of the Cecocolon, Their Clinical Significance John L. Kantor and Samuel Schechter Am Jour Roentgenol and Rad Ther, June 1934 31, 751-765

Normally, the ascending colon becomes attached to the posterior abdominal wall by about the sixth or seventh month of fetal life. Departures from this normal may be an arrest in the process of fixation with persistence of the primitive mesentery and increased mobility or abnormal progression of fixation resulting in excessive adhesions. At times the former may cause excessive adhesions. The principal points at which a normal fixation of the right colon may become accentuated are at the beginning transverse portion, hepatic flexure, and at the cecum. An atypical one is the pericolic hyperfixation, or Jackson's veil.

The average location roentgenographically of the hepatic flexure in the prone position nine hours after a standard opaque meal is slightly over three inches above the crest of the ilium. It is about one half inch higher in males than in females. In the erect posture, the average position is slightly less than one and one half inches above the ileum and about two-thirds inch higher in males than females. The average position of the cecum in the prone is about one and one-half inches above the top of the right acetabulum, being one inch higher in males than females. In the erect posture the average is one sixth inch above the acetabulum and one inch higher in males than in females.

The average length of the cecocolon, both prone and erect is 6.82 inches. In females it is one fourth inch greater in the prone and one-tenth inch greater in the erect position than in males. The greatest vertical mobility of the hepatic flexure was $4\frac{3}{4}$ inches and of the cecum $4\frac{1}{4}$ inches. The average range of mobility in the shift from the prone to the erect position was $1\frac{1}{2}$ inches for the hepatic flexure and $1\frac{1}{2}$ inch for the cecum. The greater mobility of the hepatic flexure which occurred in 61 per cent may be due to shift in the plane.

Am Jour Roentgenol and Rad Ther, June, 1934, 31, 745-750

In the first study small chilled lead shot were placed under the serosal coat of the stomach of cats and these stomachs were studied roentgenologically with the use of air or barium suspended in various fluids. Pressure conditions were measured by air through a tube.

"Hunger contractions" in the fasting stomach were not demonstrated fluoroscopically except in one cat that showed much gas in the stomach, but of eight films, each including 100 roentgenograms, seven showed shallow peristaltic contractions. It seems that the large amplitude of contractions seen when the balloon is used is due to the stimulus of distention.

On an empty stomach the *Magenstrasse* (lesser curvature) is not functionally distinguished either with small or larger quantities of food, liquid or solid. The lesser curvature is followed only when small amounts of material enter a stomach already filled with solid food. Large amounts entering a full stomach spread from the cardia out around the food already present.

Up to a certain point the stomach relaxes as it fills but beyond that point the intragastric pressure increases. The parts relaxing were shown to be the fundus and upper and outer parts of the body only. The increase is due to stretching of the abdominal walls. With increased pressure, as produced by resection of the fundus, the emptying time was shortened.

During digestion, liquefaction of the food occurs first in the pylorus and is due probably to the more active peristalsis in this region, also to the trickling down from above. When solids and fluids are mixed, the fluids leave first and this phenomenon is probably due to the peristaltic waves acting like the hand of a miler.

In the second study, with lead shot placed under the visceral serosa of the two curvatures of the stomach, pyloric ring and contours of the duodenum in cats, cinematographic roentgenographic records of every phase of gastric activity were made. The conclusions were that the pylorus responds as the adjacent part of the pars pylorica, that food leaves the stomach when the pylorus and duodenum are relaxed at the same time, and that relaxation of the pylorus alone is not followed by passage of food.

The emptying time of different foodstuffs depends first on the physical condition, consistency, and size of the particles, and second on the chemical nature of the substance. Fats and hypertonic solutions of salt or sugar had the most conspicuous effect in slowing the emptying of the stomach. The reason for the slowing is due to marked changes in the activity of the gastric and duodenal walls, since slow emptying persisted even after the removal of the pyloric ring and after gastro-enterostomy.

S M ATKINS, M D

Roentgen Diagnosis of Diseases of the Colon. An Evaluation of Methods. Harry M Weber. Am Jour Roentgenol and Rad Ther, May 1934, 31, 607-613.

After reviewing the history of examination of the

colon roentgenologically, the author notes that the current methods of visualizing the large bowel are the contrast meal, the contrast enema, the study of the mucosal relief and the double contrast enema. Although the contrast meal is the most nearly physiologic, nevertheless, the weight of the meal and the various methods of its preparation cast doubt on its action being like that of an ordinary meal. Obstruction when present in high degree is made manifest, but the accumulation of the material above the obstruction is bad.

Local or general hypermotility observed in ulcerative lesions is fairly constant, but this is only an indirect sign, whereas other methods can show the condition directly. When this method is rigidly controlled, as in recognition of intestinal tuberculosis, the evidence supplied merits consideration.

Roentgenoscopic observation of the contrast enema is the method of maximal efficiency for all types of disease, since not only are there revealed the visual elements but also those supplied by topical manipulation, mobility, flexibility, and the character and persistence of defects can be noted. In most instances of organic disease it is possible to elaborate a pathognomonic roentgenologic syndrome from the data elicited from this examination alone. From this examination, indications for additional refined technics are decided, such as roentgenography of the bowel while distended with the opaque enema, and special examination of the mucosa and internal topography after evacuation, both before and after distention with air or gas. Inspection of the mucosal relief and the double contrast method show changes in the mucosa and the internal topography which the older methods lacked. The double contrast method possesses the advantage of demonstrating polypi accurately. It also shows distinctly significant anatomic characteristics of lesions.

As a matter of principle, the complete roentgenologic examination will include all methods necessary for a complete diagnosis.

S M ATKINS, M D

GENITO-URINARY TRACT (DIAGNOSIS)

Fatal Gonococcal Pyemia Following Internal Urethrotomy. Geoffrey E Parker. British Jour Urol, December 1934, 6, 363, 364.

The author reports a case of fatal gonococcal pyemia following internal urethrotomy. Many metastatic foci developed, followed by the ultimate death of the patient from suppression of urine.

DAVIS H PARDOLL, M D

Report of a Case of Tuberculosis of Urinary Tract with Some Evidence of Spontaneous Healing. J Gray and S T Hsiu. British Jour Urol, December, 1934, 6, 357-363.

The author reports a case of tuberculosis of the urinary tract with some evidence of spontaneous healing.

DAVIS H PARDOLL, M D

blood cells may be noted. The sigmoidoscopic examination is primarily important in ruling out early ulcerative colitis, amoebic dysentery, rectal ulcer, and neoplasm of the rectum and lower sigmoid. This examination should always be made.

Visualization by the roentgen ray of different portions of the gastro intestinal tract is chiefly of value in demonstrating or ruling out pathologic conditions not related to form or function.

The most important procedure is to follow the barium meal down through the tract, to judge approximately the disturbance of motility and the degree of irritability, stasis, and fermentative processes. The normal bowel is usually only partially empty, while in the irritable bowel only a trace of barium is left in the colon. The barium enema is important, but since it relaxes spasm it may mislead the observer entirely as to the motor function of the bowel.

Irritability may vary at different periods from the normal to varying degrees of general spasticity segmental irritation phenomena, hurried or delayed emptying, a spastic sigmoid with a large dilated cecum, a feathery descending colon simulating the appearance of the small bowel and occasionally (10 per cent) the string sign."

Treatment is essentially soothing and sedative, reconstructive both psychologically and physically. It must include a regimen of colon management which the author has outlined in detail.

CHARLES G. SUTHERLAND, M.D.

Regional (Terminal) Ileitis. Its Roentgen Diagnosis
John L. Kantor. Jour. Am. Med. Assn., Dec. 29, 1934, 103, 2016-2020.

Following the ingestion of the standard opaque meal, administered on an empty stomach, observations are made at hourly intervals from three to nine hours after the ingestion of the opaque meal. The patient is allowed to take an ordinary meal as soon as the stomach is seen to empty, normally five hours after the barium meal. The changes in the colon are usually the result of spasm secondary to the ileac involvement. The spasm in ileitis takes the form of a contracture, sometimes of the entire cecocolon but most characteristically of the cecum proper. There is often a marked spasm of the sphincter of Busi (a sphincter separating the cecal tip from the cecum above it), as well as of the cecal tip so that this segment assumes a special bud-like or teat-like appearance. In most cases of spasm of the cecum or cecocolon the changes are not constant when functional but intermittent. Furthermore the opaque enema usually suffices to fill out the involved areas in normal fashion.

On the other hand, the colon may be actually involved by the disease process in the adjacent ileum as by adhesion or fistula formation. In such instances a fixed deformity results most commonly affecting the inner (mesial) aspect of the large intestine. There is a constant defect in the filling of the terminal small intestine. The extent of this ileac filling defect depends on the extent of the stenotic process in the small intestine.

In three of the author's six cases the ileum proximal to the filling defect seemed abnormal in contour. The involved loops appeared irregular in shape, or else the very last segment of ileum showed a peculiar taper point. In some cases this taper point became continuous with a thin, slightly irregular linear shadow suggesting a cotton string in appearance and extending more or less continuously from the region of the last visualized loop of ileum through the entire extent of the filling defect to the ileocecal valve. This latter is the "string sign" and represents the attenuated barium filling of the greatly contracted intestinal lumen. Multiple or branched "string signs" may be attributed to multiple areas of involvement or to fistula formation.

In differential diagnosis it is characteristic of regional ileitis that the "string sign" remain constant in location at repeated observations. This sign is not necessarily pathognomonic of regional ileitis, but its presence should suggest the disease.

CHARLES G. SUTHERLAND, M.D.

Duodenitis and its Roentgenologic Characteristics
B. R. Kirklin. Am. Jour. Roentgenol. and Rad. Ther. May, 1934, 31, 581-587.

Duodenitis is held by MacCarty and Nagel to be an antecedent lesion to ulcer although this is denied by Hauser, Büchner, Knötzke, and Radecke. Grossly duodenitis shows hyperemia and stippling of the mucosa without induration of the wall and more or less diffused inflammation of the mucosa, with at times, small superficial erosions which bleed easily. Microscopically there is cellular destruction, congestion, and edema, with migration of leukocytes, lymphocytes and endothelial cells. Clinically there are no notable differences in the individual with duodenitis as compared with the one suffering from an actual ulcer. Roentgenologically these criteria for making a diagnosis of duodenitis are tentatively offered by Kirklin: irritability of the bulb, with rapid emptying and pronounced but unstable deformity, indistinctness of bulb outline, absence of niche or crater, and absence of gastric retention. There is, at times a rather characteristic, coarsely reticulated mucosal pattern. Of 92 cases roentgenologically diagnosed as uncomplicated duodenitis only eight were submitted to surgery, the remainder being cases considered suitable for medical care. In several cases ulcer and duodenitis co-existed both lesions being recognized to be present by roentgen examination prior to operation.

J. E. HABBE, M.D.

Some Mechanical Factors of Gastric Physiology
Study I. The Empty Stomach and its Various Ways of Filling. The Pressure Exerted by the Gastric Walls on the Gastric Content. The Physical Changes Occurring to the Foodstuff during Digestion. Cesare Granturco. Am. Jour. Roentgenol. and Rad. Ther. June 1934, 31, 735-744.

Some Mechanical Factors of Gastric Physiology
Study II. The Pyloric Mechanism—The Effect of Various Foods on the Emptying of the Stomach.

Personal Technic for the Cure of Epispadias in Women Oscar Mercier *British Jour Urol*, December, 1934, 6, 313-319

The author describes his personal technic for the cure of epispadias in women. Many illustrations describing the steps for the eradication of this condition are reproduced in the article. His success is largely dependent upon the fact that the tissues of the incomplete sphincter are brought together to surround a reformed urethral canal.

DAVIS H. PARDOLL, M.D.

HEART AND VASCULAR SYSTEM

Congenital Cardiac Disease in Infants, with a Discussion of Tracheal Displacement as a Roentgen Sign Eugene P. Pendergrass and M. Lowry Allen *Am Jour Roentgenol and Rad Ther*, April, 1934, 31, 470-481

Tracheal displacement in inspiration was radiographically demonstrated in nine cases of congenital heart disease. All showed abnormal posterior displacement, while six showed definite right lateral, and one, left lateral displacement. In some, the maximal displacement was as high as the suprasternal notch, in others as low as the bifurcation. It is the writers' belief that the displacement is most commonly the result of abnormal relationship of the great vessels which are in close relationship to the trachea. The tracheal displacement is similar to that noted in thymic enlargement, differentiation as to cause which cannot be made taking the other abnormal x-ray findings into consideration may be aided by the therapeutic test, the abnormal finding disappearing promptly after irradiation if caused by the thymus, but, of course, persisting if due to congenital heart disease.

Accurate positioning in both the postero-anterior and lateral positions is, of course, essential to accurate interpretation of tracheal deviation. Films are taken in both the inspiratory and expiratory phases with the subject erect. Deviation or buckling is normally encountered in the expiratory phase film.

The authors warn that this observation has been made only in infants and, therefore, it is not to be assumed that older children or adults will show the same sign with the same frequency.

J. E. HABBE, M.D.

Roentgen Diagnosis of Coronary Disease. George Levine, Frank E. Wheatley, and Helen Matthews *Am Jour Roentgenol and Rad Ther*, May, 1934, 31, 588-592

Roentgen manifestations of coronary disease are gross visual evidence of pathologic cardiac physiology. The pathologic changes may attack all of the coronary vessels although the one most commonly and extensively involved is the left circumflex. With thrombus formation, the myocardium supplied by the involved branch becomes first edematous and anemic later an infarct forms with predisposition to aneurysm formation.

The bisector measurement of the left ventricle is a summation of two values—the thickness of the ventricle muscle and the muscle tone. In ventricular hypertrophy, the bisector increases above the normal figure of 8 to 10 mm, while in myocardial impairment there is loss of tone, with resultant decrease of the bisector.

The typical appearance of myocardial disease is, therefore, a straight left cardiac contour, a small bisector, low placed right and left median diameters and greatly diminished cardiac contractions.

If there has been a long-standing antecedent hypertension the roentgenographic picture will be atypical in that the left ventricular contour may still be rounded and the bisector large, however, the contractions remain characteristically weak. Not infrequently in this latter type of case there will be a functional mitral insufficiency.

J. E. HABBE, M.D.

Myocardial Calcification John J. Moore *Am Jour Roentgenol and Rad Ther*, June, 1934, 31, 766-769

In contrast to cases of pericardial calcification shown roentgenologically, proven cases of myocardial calcification so demonstrated and confirmed by necropsy are rather rare. The author's case was that of a male, aged 60 years, who had complained of precordial pain, brought on by exertion, for a short period of time prior to death, although the patient had been aware of "heart trouble" for about nine years. On previous examinations he had complained of sinus trouble and had shown normal blood pressure readings of 135/80. About two months prior to death, his heart was examined roentgenologically for the first time. This study revealed an ovoid area of calcification of basket-weave appearance, measuring $7 \times 6 \times 5$ cm, lying in the wall of the left ventricle. Also, a ring-like area of calcification was seen in the vicinity of the mitral valve. Less than two months after detection of the mural calcification, the patient suffered an acute attack of precordial pain, showed an irregular pulse, and a blood pressure of 78/55, he died the same day. A postmortem study showed a heart weighing 545 grams, the wall of the left ventricle bulging and containing a large deposit of calcium within it. The myocardium elsewhere appeared normal. Both coronaries were quite sclerotic, the immediate cause of death being attributed to occlusion of a branch of the left.

J. E. HABBE, M.D.

Roentgen Therapy of Carditis and Aortitis Boris Jegorow *Strahlentherapie* 1935, 52, 97-100

The author relates in a preliminary report his experience with roentgen therapy of inflammatory lesions of the heart and aorta. The technic was that used as a rule in inflammatory lesions: three to five sittings were given once a week and, if repeated, at intervals of from one and a half to three months. Most striking was the relief from pain particularly in pericarditis and myocarditis. Seven cases of endocarditis lenta were

The Roentgenogram of Hydronephrosis Due to an Aberrant Blood Vessel Jeplens and Loeweneck *Röntgenpraxis*, July, 1934 6, 421-424

In 18 out of 40 cases of hydronephrosis an aberrant blood vessel with or without peri ureteritis was the cause for the dilatation of the kidney pelvis. All cases were checked by operation. In order to show the uretero-pelvic junction best on roentgenograms the authors employ first an intravenous pyelogram. If that looks suggestive, a large catheter is introduced into the ureter and the patient is examined fluoroscopically in standing and prone positions. After the best position for showing the uppermost portions of the ureter has been found fluoroscopically, a film is immediately taken with the apparatus of Berg for instantaneous exposures. If the ureter is smooth, but kinked, one is dealing with an aberrant vessel, if it is kinked and irregular in contour, there is always some scar like thickening around the ureter.

HANS W. HEFKE, M.D.

Granuloma of the Bladder A. F. Weyerbacher and James F. Balch *Am Jour Surg*, January, 1935, 27, 168-170

Granuloma of the bladder, although frequently encountered by the urologist, has received little attention in the literature. Because hematuria and pyuria frequently occur with granuloma, it is of real importance from a clinical standpoint. A correct diagnosis of granuloma of the bladder presupposes proper management of the case.

DAVIS H. PARDOLL, M.D.

Traumatic Interstitial Hernia of the Bladder Richard Joseph White *Am Jour Surg*, January, 1935, 27, 174-176

It is hard to see any explanation of the unusual findings here presented except sudden, severe pressure on a distended bladder which, instead of rupturing, forced a portion of its wall through the fibers of an ordinarily very strong tendinous structure. The latter may have been weakened by former wearing of a truss. In any case, the lateral pressure of the tense fibers of the tendon evidently allowed more fluid to go into the artificial pouch when the bladder was distended than it permitted to flow back when the bladder was empty.

The interchange must have taken place or infection would surely have resulted. Likewise it must surely have been very slow or a recognizable change in size in the swelling when the bladder was emptied could have been detected. The relief from pain on voiding secured by pulling the mass laterally was probably due to the fact that the wall of the pouch was thus brought in line with the oblique tear through the tendon lessening the pressure of the sharp inner fascial edge against it.

DAVIS H. PARDOLL, M.D.

GOITER (THERAPY)

The Roentgen Therapy of Flajani-Basedow's Disease Eugenia Jona *Arch di Radiol*, 1934, 10, Pt 1 377-414

The author reports a detailed clinical and laboratory study of nine cases of exophthalmic goiter made after x-ray treatment.

E. T. LEDDY, M.D.

GYNECOLOGY

Roentgenologic Diagnosis of Placenta Previa Walter H. Ude and John A. Urner *Minnesota Med*, January, 1935, 18, 9-11

The authors succeeded in demonstrating roentgenologically the presence of placenta previa in 14 patients of a series of about 35 cases of abnormal uterine hemorrhage. In all of the cases, independent clinical examinations were carefully and thoroughly performed and the results obtained by the use of the roentgen ray confirmed the clinical diagnosis in each case.

In 1930, Menees, Miller, and Holly reported their method of roentgenologic visualization of the placenta by the injection of a solution of strontium iodide through the anterior abdominal wall into the amniotic cavity. It is believed, however, that this method may be dangerous to the fetus, and may result in premature delivery. Kerr and Mackay substituted a derivative of iopax for the strontium iodide but it is thought that the termination of pregnancy may result from this injection. Snow and Powell later demonstrated the outline of the normally implanted placenta without the injection of a contrast medium. The authors subsequently reported the roentgenologic diagnosis of placenta previa in a case of uterine hemorrhage, in which the clinical diagnosis was placenta previa. This was confirmed after operation.

The authors' technic consists of the injection of not more than 40 c.c. of sodium iodide or other contrast medium into the urinary bladder after catheterization. This is done to clearly define the upper margin of the bladder. The roentgenogram is then made with the central ray directed vertically over the lower abdomen.

In the normal case of pregnancy with the fetal head presenting in the lower uterine segment, the normal soft tissue space between the cranial bones of the fetus and the contrast material in the bladder consists of the thin scalp of the fetus, the wall of the lower uterine segment, the fold of the peritoneum, and the relatively thin wall of the bladder. The roentgenogram reveals this area as a narrow band of tissue, scarcely exceeding one centimeter, between the two landmarks. In the presence of placenta previa this space is widened and usually the outline of the placental mass may be seen on the film. It has been possible for the authors to distinguish between central and partial types of placenta previa by a study of the size and position of the placental mass in the lower uterine segment. While it was impossible to apply this method to a case of transverse presentation associated with placenta previa, it is believed that in the case of breech presentation the outline of the breech should give a sufficiently clear definition of the upper margin of the placental mass.

J. N. ANÉ, M.D.

to be just the opposite " While it is possible to demonstrate an erosion of the petrous apex roentgenographically, the interpretation of a petrositis should not be made except with careful correlation of the clinical findings, and preferably by demonstrating changes by serial studies

J E HABBE, M D

PARKINSON'S DISEASE

Parkinson's Disease Nandor Kiss and Bela Szirmai Röntgenpraxis, November 1934, 6, 746-748

Eight patients with Parkinson's disease were treated by the authors, six of them post-encephalitic. The two cases in older individuals were not benefited by treatments, while all six post-encephalitic cases were definitely improved for as long as six months. X-ray treatment is only a symptomatic treatment based on the influence of the rays on the sympathetic nervous system. It is, therefore, impossible to achieve complete cure, but the marked symptomatic improvement is much worth while. The treatment can be repeated best after an interval of six months. The region of the superior thoracic and inferior and median cervical ganglia is irradiated with fairly large doses of fractionated treatments.

HANS W HEFKE, M D

THE PROSTATE

Sarcoma of the Prostate Oswald S Lowsley and Francis N Kimball British Jour Urol, December 1934 6, 328-348

This analysis is based on 132 reported cases in which the diagnosis is undisputed.

Prostatic sarcoma is common to all ages. 35.59 per cent of cases occur before the age of 20. Prostatic sarcoma is most frequently associated with an infiltration of the urinary bladder, seminal vesicles and rectum.

Regional extension occurs in 76.51 per cent of the cases. It is most frequently met with in the round-cell type and is most frequent during the first decade.

Metastases are most frequently seen in the round and spindle-cell sarcomas, which are also the most malignant types.

Metastases occur most frequently by way of the lymphatics, the kidney being the most frequent site of metastatic implantation.

The most favorable results in treatment have been by the use of the x-ray and radium. Operative intervention should be limited to relief of obstruction and the treatment of complications.

DAVIS H PARDOLL, M D

RADIATION EFFECTS

The Effect of Short and Ultra short Electric Waves on Anorganic and Organic Compounds E Hasché and H Leunig Strahlentherapie, 1935 52, 179-186

The authors studied the effect of electric waves of

from 3.5 to 21 meters on blood serum, chicken protein, starch, metal colloids, phosphor, silver chromide, and other anorganic substances. No specific change of any of these could be detected, even after exposure to these waves for several hours. Changes observed in the protein of the human body were apparently due to heat.

ERNST A POHLE, M D, Ph D

RADIUM

Radon Ingestion and its Possible Health Dangers Howard H Barker Am Jour Roentgenol and Rad Ther, May, 1934, 31, 673-675

Assuming an operator is engaged in the application of self luminous material to clock dials for 8 hours a day, 5 days a week, and 50 weeks per year, and knowing the average radon content of workshop to day, as has been proven by competent investigators, it can be shown mathematically that in all probability there is no hazard to the operator. The alpha-ray exposure is no more than it would be if there was permanently deposited in the system 0.00004 microgram of radium element—totally insignificant. The alpha radiation from the polonium formed from the active deposit is slight, probably 2 per cent of the alpha radiation produced by the radon. The chance of accumulation of the active deposit of slow change in the system is practically nil. The possibility of harmful effects from ingestion of radon as administered therapeutically, either by inhalation or injection, is very remote.

S M ATKINS M D

Contribution to the Dosimetry of Radium Rays P Dumont Strahlentherapie, 1935, 52, 152-161

The distribution of radiation given off by radium applicators can be determined accurately only if the radioactive substance is immovable within the carrier. A number of tests carried out by the author showed that the radioactive substance sealed in radium tubes is movable and that the distribution of the radiant energy depends on the position of the screen. It seems best, therefore, to use small applicators because the radioactive substance is much less movable than in the larger size.

ERNST A POHLE, M D, Ph D

Sterilization of Radium and Mesothorium Needles for Surgical Purposes W Gericke and H Leunig Strahlentherapie 1935 52, 162-166

The authors studied the various methods for sterilizing radium and mesothorium needles. They found that boiling water is tolerated well by radioactive needles. The radiation itself emitted by needles filtered through 0.2-0.5 mm Pt does not sterilize their surface. Alcohol and ether disinfection does not sterilize them in all instances. The best method for sterilizing radium needles is therefore boiling water.

ERNST A POHLE M D Ph D

also irradiated Four of the patients died, probably because roentgen rays were used in the end stage of the disease, while three recovered one has been under observation for two years and nine months

ERNST A POHLE, M D , Ph D

HEMOPHILIA

The Roentgen Ray as an Aid in the Diagnosis of Hemophilia Edwin L Rypins *Am Jour Roentgenol and Rad Ther*, May, 1934, 31, 597-602

In a review of the reproductions of the roentgenograms of various authors on hemophilic joints, and a study of three of his own cases, the author demonstrates that there are characteristic changes in the knee joints in cases in which they have been the seat of previous hemorrhage The intercondylar fossa of the femur shows widening and deepening, with or without arthritic changes When the elbow is involved, the head of the radius shows marked flattening and enlargement In both joints, hiping may be present Other conditions do not cause quite the same changes

S M ATKINS, M D

INFLAMMATORY DISEASES

Roentgen Therapy of Pelvic Inflammatory Disease Andreas Dapsy *Strahlentherapie*, 1935, 52, 85-96

The author treated 40 cases of pelvic inflammatory disease with small doses of roentgen rays (160 K V, 15 to 20 per cent H E D on the skin, 30 cm F S D, two or three times at weekly intervals) Six were acute cases, 11 subacute, and 23 chronic cases The blood picture and the sedimentation velocity of the erythrocytes were carefully studied Two of the subacute and two of the chronic cases were cured Two of the acute, two of the subacute, and five of the chronic cases showed marked improvement No change was seen in three acute, five subacute, and fifteen chronic cases Abscess formation occurred in one subacute and one chronic case Since the percentage of cure was relatively small namely, only 10 per cent, the author recommends that roentgen therapy should be used in such cases only as have failed to show improvement with every other type of therapy

ERNST A POHLE, M D Ph D

THE KIDNEYS

Congenital Absence of One Kidney Margaret Moore White *British Jour Urol* December 1934 6, 354-357

The author reports two cases of congenital absence of one kidney

DAVIS H PARDOLL M D

Echinococcus Cyst Attached to Kidney Case Report M J Geyman and D M Clark *Am Jour Roentgenol and Rad Ther* April 1934 31, 541-542

The authors report a case of echinococcus cyst at-

tached to the kidney, and quote statistics to the effect that 75 per cent of these cysts are in the liver, the next most common site is the lungs, and other locations are extremely rare When the wall is not calcareous those arising from the lower edge can be demonstrated better with inflation of the colon with air The demonstration of those within the liver, the authors feel, should be aided by thorotrast

S M ATKINS M D

THE LUNGS

The Radiologic Picture of Bronchiectasis Mario Belli *Arch di Radiol*, 1934, 10, Pt. 1, 321-353

Belli (from the Consorzio e dispensario provinciale antituberculare di Milano) feels that in the diagnosis of bronchiectasis the ordinary x ray examination is less valuable than the usual clinical examination, and is of no value when the lesion is behind the heart shadow and also even, in some cases in which the lesion lies outside the cardiac shadow With suitable roentgenologic technic it is possible to show in the great majority of cases, some indirect signs of the greatest value in making a diagnosis in cases in which bronchiectasis is only suspected In some typical cases a diagnosis may be made by the clinical and roentgenologic findings Belli is of the opinion that bronchographic methods of examination are the most certain ones, especially in those cases in which it is important to localize the bronchiectatic area and to determine its extent for surgical reasons He illustrates some typical roentgenologic findings in this group

E T LEDDY, M D

THE MASTOIDS

Roentgen Examination of the Mastoid Processes Frederick M Law *Am Jour Roentgenol and Rad Ther* April, 1934, 31, 482-486

For obtaining complete roentgenologic data both with reference to the anatomy and the pathology of the mastoid process, the author recommends the routine use of the 15° angle position the vertex mental view, and the 23° angle postero-anterior view all made stereoscopically and at times, supplementary study to be made using the Arcelin or Granger positions The vertex-mental view is made as a matter of record to determine the appearance of the petrous bone and tip of the pyramid in case complications arise requiring subsequent consideration of the possibility of a petrositis For demonstrating a cholesteatoma a denser than usual exposure is necessary, the Granger projection is helpful in determining its depth All cases with a history of chronic discharge should have the benefit of denser films in order to demonstrate a possible eroded cavity Stereoscopic films are considered absolutely essential for a correct interpretation of early softening of the deeper cells lying between the posterior canal wall and the wall of the sinus According to the author a technically perfect film never shows the condition worse than it is it is more likely

tumors originating in that membrane The radiosensitivity of the skin is independent thereof It is possible to reduce the reactions in both skin and mucous membrane by short wave therapy and infra red exposures A number of photographs show various types of reactions observed by the author

ERNST A. POHLE, M D, Ph D

THE STOMACH

The Treatment of Extensive Malignant Lesions of the Stomach Waltman Walters Jour Am Med Assn, Nov 3, 1934 103, 1345-1348

Carcinoma of the stomach can be detected by a competent roentgenologist in 95 per cent of cases, and roentgenographic examination of the stomach of patients 40 years of age or more who have indeterminate dyspepsia is the most important procedure in the examination, never to be omitted in any suspicious case Every gastric lesion should be regarded as malignant, or potentially so until proved otherwise The decision to treat a patient with an ulcerating gastric lesion by medical measures carries a great responsibility, for if the lesion is malignant, by the time it is found to respond unsatisfactorily to medical treatment sufficient time may have elapsed for it to have become completely irremovable. The recognition of the fact that the small gastric ulcer is frequently malignant, as likewise may be other small lesions of the stomach such as polypi will frequently enable an attack to be made on such lesions while they are in stages most favorable to cure

CHARLES G. SUTHERLAND M D

THE TONSILS

Roentgen Therapy of Tonsillitis E D Dubowyr and E I Olschanowsky Röntgenpraxis, July, 1934, 6, 441-447

After reviewing the literature pertaining to roentgen therapy of tonsillitis the authors report their results with this treatment in 163 patients During two years they irradiated 450 patients with tonsillitis, but did not use all of them for statistical purposes because sufficient time had not elapsed since their treatments The clinical selection and the grouping of the patients was apparently done with great care and the criteria for cure or improvement were strict In chronic tonsillitis, 62 per cent were cured, 33 per cent improved, and only 4 per cent not influenced, in hypertrophy of the tonsils, 66 per cent were cured 28 per cent improved, and 6 per cent not influenced, in hypertrophy of the entire lymphatic ring, 69 per cent were cured, the remaining number improved Recurrent attacks of tonsillitis were seen only twice after roentgen therapy, even if the size of the tonsils was not changed The technic was 210 kilovolts, a filter of 1 mm Cu and 2 mm Al, a skin focus distance of 25 cm, from 20 to 30 per cent of an erythema dose through a field measuring 5 X 6 cm or 6 X 8 cm applied in both infra mandibular areas Of the patients, 27 per cent received only one series, 57 per cent two 14 per cent three and 2 per cent four

series The authors do not believe that such treatment can be in any way harmful, not even in children

HANS W. HEFKE, M D

TUBERCULOSIS, PULMONARY

The Specificity of Pulmonary Consolidation in Tuberculous Patients (Epituberculosis) Resolution of Experimental Tuberculous Pneumonia Henry Stuart Willis Am Jour Roentgenol and Rad Ther, June, 1934, 31, 721-734

Primary consolidation which occurs with moderate frequency in tuberculous individuals, especially children, is due to tuberculosis rather than atelectasis, edema, pneumococcus pneumonia, or non-specific pneumonia Some have called this "epituberculosis" These cases offer several points that make a diagnosis of tuberculosis almost mandatory, namely, the long duration, lack of stormy symptoms positive tuberculin reaction, positive sputum (in many cases), histologic appearance, and the reappearance of the condition in children after injection of tuberculin The positive sputum especially may be present during the height of the consolidation

Experimental work on this condition was performed on rabbits, the larger portion of the experiment being concerned with the introduction of human tubercle bacilli into previously tuberculosis infected (sensitive) animals The results definitely bore out the premise of the paper both roentgenologically and pathologically

S M ATKINS, M D

TUMORS (DIAGNOSIS)

Multiple Fibromas of the Tunica Vaginalis G Gordon Taylor British Jour Urol, December, 1934, 6, 320-327

The author describes a case of multiple fibromas of the tunica vaginalis A review of the literature and several illustrations accompany the article

DAVIS H. PARDOLL, M D

TUMORS (THERAPY)

The Hemangio-endothelioma and its Susceptibility to Irradiation Rudolf Baumann-Schenker Strahlentherapie, 1935 52, 11-19

The author reports five cases of hemangio-endothelioma, which seems to occur more frequently in goiter areas These tumors are radiosensitive, sometimes as much as a lymphoblastoma Even bone metastases may respond well The total doses applied in these five cases varied from 1 200 to 6,900 r Two patients died, two were still well eight months and two and a half years, respectively, after the treatment One case was treated by a combination of surgery and irradiation and was still well six months later

ERNST A. POHLE, M D Ph D

The Problem of the Treatment of Malignant Tumors Paolo Buisson Arch di Radiol, 1934, 10, Pt 1 354-363

RESPIRATORY TRACT

Dyspnea J C Meakins Jour Am Med Assn
Nov 10, 1934, 103, 1442-1445

Ordinarily in the healthy individual respiration is an unconscious function although it can be modified at will. This review concerns itself with the unconscious or spontaneous act of respiration. The turnover from inspiration to expiration is brought about by what is commonly called the Hering-Breuer reflex, which is supposed to depend on variations in tension of the alveolar walls. The pathway for the afferent impulses is through the vagus, while the efferent impulses pass by way of the phrenic and spinal nerves. There is strong evidence to suggest that in the mid brain (anatomically vague but physiologically fairly definite) there is an area called the respiratory center, which initiates the respiratory rhythm and controls the points of the reflex. This center is in its turn responsive to its own hydrogen ion concentration which is one of the most constant of the internal equilibria. The control of respiration depends on two factors, one chemical, the other nervous.

Dyspnea can be produced by either increased acidity or decreased oxygenation of the respiratory center. But there is also a local pulmonary factor which may be of profound significance in the genesis of dyspnea. Any condition, such as pulmonary engorgement, that decreases the distensibility of the lung will exaggerate the excitability of the Hering-Breuer reflex. In other words, any condition that increases the rigidity of the lung will tend to produce rapid and shallow breathing, with dyspnea.

Attempts to correlate the degree of dyspnea with various measurements such as the vital capacity and the ventilation equivalent have been shown to be thoroughly untrustworthy. It can be shown that the degree of respiratory impairment is directly proportional to the ratio of the functional residual air to total capacity of air. In obstruction asthma, emphysema, and probably in pneumonococcosis, the functional disturbances of respiration are chiefly inherent in the difficulties of expiration. Inspiration is accomplished by the action of a strong muscular mechanism. Expiration is ordinarily a passive act furthered by the negative intrapleural pressure, but in those conditions due to the loss of elasticity it is transformed into an active function producing a positive intrapleural pressure, which in time, undoubtedly will be harmful to the return flow of the venous blood.

CHARLES G. SUTHERLAND M.D.

SALIOGRAPHY

The Technic of Saliography E. Simon Röntgenpraxis, July 1934 6, 471-480

The author reports his experience with saliography, that is, the roentgenological examination of the salivary glands after the introduction of contrast material. The first attempts by using skiodan were not successful. 40 per cent iodipin oil is the proper substance. The papilla of Stenon's duct is slightly dilated by a

probe, then a long cannula with a small olive on its end is introduced—the olive prohibits escape of the iodinated oil into the mouth. Anesthesia is not necessary. After two or three, sometimes five, c.c. of the contrast substance have been injected, the gland feels tense. A straight lateral roentgenogram of the mandibular region is made. Several cases are described, illustrating the value of this type of examination in diseases of the parotid gland. Occasionally the sublingual gland may have to be examined in a similar way, such a case is also reported.

HANS W. HEFKE M.D.

SINUSES (DIAGNOSIS)

Anomalies in the Position of the Planum Sphenoidale and Their Diagnostic Significance Ernst G. Mayer Röntgenpraxis July, 1934 6, 427-431

The sphenoidal plane is that portion of the upper bony wall of the sphenoidal sinus which lies just anterior to the anterior clinoid process. Its level is usually just a little lower than the upper edges of the small wings of the sphenoid bone. A very low planum sphenoidale may be caused by pressure of a tumor above or by a very marked increase of the intracranial pressure. An elevation of this plane has been observed by several authors. It is caused by meningiomas (in combination with an osteoma like thickening), mucocoeles of the sphenoid sinuses and osteomas. Several cases are described.

HANS W. HEFKE, M.D.

THE SKIN

The Regional Variations in the Skin Reaction J. Borak Strahlentherapie, 1935 52, 74-84

The author observed that in certain patients there is a difference in the skin reaction in different parts of the body following the application of identical doses. A study of this problem leads him to the conclusion that the parts of the skin which are close to the bone react less than other skin. This difference in susceptibility is shown by the epidermis as well as by the blood vessels. He offers a hypothesis in an attempt to explain this difference in reaction.

ERNST A. POHLE, M.D. Ph.D.

Reactions in Skin and Mucous Membrane Following Protracted Fractional Roentgen Therapy R. Sarasin Strahlentherapie 1935 52, 61-73

The author has studied the reactions developing in patients following treatment with the Coutard technic. He emphasizes that this type of therapy has to be strictly individualized. Skin reaction and mucous membrane reactions do not run parallel. It is possible to determine the approximate date on which the reaction in the mucous membrane will appear. Its intensity and duration must be adjusted to the requirements of each patient. There is a definite relation between the radiosensitivity of the mucous membrane and that of

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XANTHOMATOSIS INVOLVING BONE (LIPOID HISTIOCYTOSIS)¹

CASE REPORTS AND ROENTGEN FINDINGS

By LESTER A. SMITH, M.D., *Indianapolis, Indiana*

THE concept of xanthomatosis includes a series of pathological conditions, in which lipoid substances are deposited in certain tissues of the body as a result of a disturbance of fat metabolism, which may be an essential primary process or one secondary to other constitutional disease, such as diabetes mellitus. These accumulations are found in various tissues, the composite picture differing greatly over a rather wide range of clinical cases, but in general considered by present-day investigators to represent a fundamentally similar pathologic process in all. It has also been variously termed "lipoid granulomatosis," "lipoid reticulo-endotheliosis," "lipoid gout," "lipoid histiocytosis," and "generalized xanthomatosis."

CASE REPORTS

Case 1 F.B., R-3680, a white boy aged three and one-half years, was admitted to the hospital July 29, 1927, with the complaint of multiple abscesses of the skull, exophthalmos of the right eye, ankylosis of the left shoulder, and pain in the region of the right hip. With him came a history of his having injured the shoulder in a fall in March, 1926. An abscess of the left tonsil had been opened in October, 1926, and one in the right temporal region arising without

history of injury or other apparent cause in January, 1927. Other swellings had since appeared on the head, but had not been opened. The right knee pained occasionally. He had been delivered normally at full term and breast fed. Scarlet fever had occurred at nine months and severe mumps in March, 1927, each with good recovery. There was no history of other infections. His father, 26 years of age, his mother, 25 years of age, and his six sisters were all in good health.

Examination—The right eye was displaced downward and outward, but was otherwise found normal upon examination by the division of ophthalmology. A soft, fluctuant, non-expansile mass about 5 × 6 cm. was present over the left parietal region, not inflamed. A soft mass 2.5 cm. in diameter underlay a sinus in the right temporal area which was discharging a serous fluid. The left shoulder was ankylosed in a position of adduction. The patient limped on the right leg, with pain in the right hip on motion. The physical findings were otherwise of no significance.

Laboratory study gave the following findings: Hemoglobin, 70 per cent, red blood cells, 3,700,000, white blood cells, 15,000 to 17,000 with polymorphonuclears (neutrophils) 50 per cent, polymorphonuclears (eosinophils) 1 per cent, lymphocytes 41 per cent, large mononuclears and transitionals 8 per cent. Anisocytosis and poikilocytosis were present. The Wassermann (Kolmer technic) was negative on three ex-

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis Tenn. Dec. 3-7, 1934.

Buisson is of the opinion that ordinary surgical and radiologic methods of treating tumors hold out little promise because they are based on the false theory that malignant tumors, at least at their outset, are local lesions. He prefers to regard malignant tumors as manifestations of a generalized disease, and thinks that they should be treated as such. In this regard he feels that pan irradiation, telepan irradiation, or supertelepan irradiation, based on the technics of Palmieri and of Heublein, promise much improvement in the results that may be obtained.

E T LEDDY, M D

The Round-cell Sarcoma. Experience at the X ray Laboratory of the University of Zurich 1919-1934. Rudolf Baumann-Schenker. *Strahlentherapie*, 1934, 51, 201-236.

Sixty cases of round-cell sarcoma subdivided in three groups, lymphosarcoma, reticulum-cell sarcoma, and round-cell sarcoma proper, are analyzed by the author. He describes the histologic and clinical character in detail. Roentgen therapy seems to be the most efficient method of treatment. In tumors of the nose and pharynx, 30 per cent of the cases remained free from symptoms for 3 years, 1 year, and 8 months, respectively. In all other types without generalized metastases 30 per cent remained free from symptoms. In patients with metastases the result was only a palliative one. Six cases of reticulum-cell sarcoma located, with one exception, in the nasopharynx, responded well to protracted fractional treatment, two are alive and well four and two and one half years, respectively after the treatment, one case is still under treatment. The experiences in the round-cell sarcoma group were similar to that in the lymphosarcoma group.

The article is accompanied by a number of very elaborate tables giving detailed information concerning the patients observed in each group of tumors. The paper is recommended for study in the original.

ERNST A. POHLE, M D, Ph D

Tumors of the Testis. Arthur U. Desjardins, Virgil S. Counseller, and Cesare Gianturco. *Am Jour Surg*, January, 1935, 27, 71-79.

Tumors of the testis are not so rare as they have been held to be. Between 1920 and 1929, 155 patients with testicular tumors have been seen at the Mayo Clinic. These are grouped and analyzed as to the age of incidence by decades and such analysis shows that the greatest number of orchidic neoplasms develop between the third and the sixth decades of life. In all but two cases, the tumor was unilateral. The relation of

testicular tumor to undescended testis and to the influence of trauma could not be ascertained.

The results of treatment are considered from the standpoint of orchidectomy alone, roentgen therapy alone, and combined orchidectomy and roentgen therapy. Tabulation of the cases in these three groups gives the impression that the results obtained by surgery combined with or followed by roentgen ray treatment, are superior. This may be misleading because none of the patients in this preferred group has presented evidence of tumor for more than one year, and all were apparently free from metastasis. The patients treated by simple orchidectomy also constituted a preferred group. In the group of cases treated with roentgen rays only, the 16 patients who had died had had an average survival period of 11 1/2 months, a period distinctly longer than corresponding cases in the two other groups.

For various reasons, absolute conclusions cannot be drawn from this review. The impression is that patients receiving combined treatment derive more benefit than patients treated by surgical methods only or by radiotherapy only, but in order to determine the relative value of each method by itself in comparable cases a more thorough test should be made.

On the whole roentgen ray treatment alone seems preferable for embryonal carcinoma, while for the mixed or teratoid, tumors surgical removal combined with thorough post operative irradiation seems indicated.

DAVIS H. PARDOLL, M D

THE WRIST

A Radiologic Study of Luxation of the Semilunar Bone. Edmondo Ingber. *Arch di Radiol*, 1934 10, Pt 1, 302-320.

Ingber discusses traumatic dislocation of the semilunar bone, of which he illustrates several cases. He emphasizes the value of the technic of Schneck (which he has modified slightly) for the demonstration of this lesion. He next illustrates the various types of dislocation of the semilunar and emphasizes the importance of a well-carried-out x ray examination in diagnosing this uncommon traumatic lesion.

This paper supplements that of Bignami on fracture of the semilunar, and of Agati on the malacia syndrome of the semilunar, from the Institute of Medical Radiology and Physical Therapy of the Royal University of Pavia.

E T LEDDY, M D



Fig 3 Case 1 Photomicrograph, low magnification Hematoxylin-eosin stain Foam-cells not numerous, a frequent cause of error

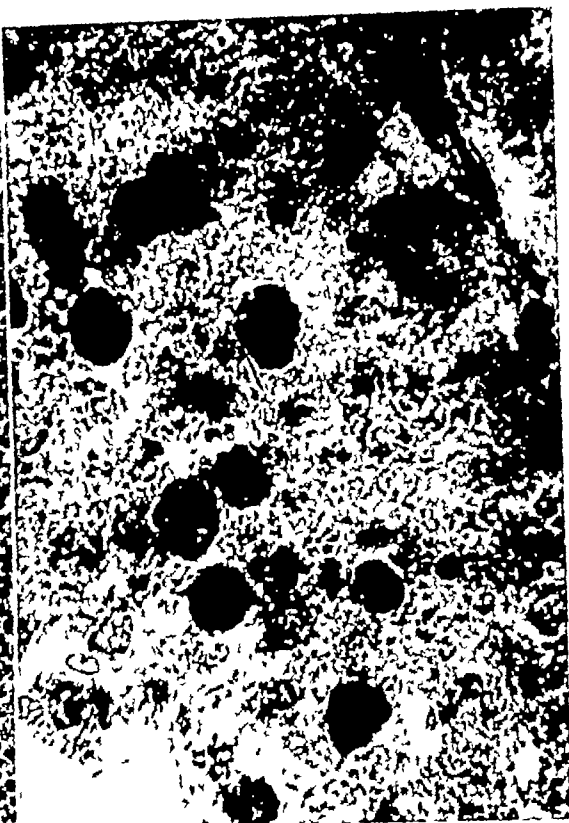


Fig 4 Case 1 Photomicrograph, high magnification Sudan III stain brings out intracellular lipoids (This study was made subsequent to roentgen diagnosis)

and giant cells similar to those previously described "

Laboratory study in February, 1928, showed blood calcium to be 9.3 to 10.7 mg per 100 c c of blood serum (method of Clark and Collip) The red blood cells numbered 5,100,000 per c mm, white blood cells 12,860, with a differential count approximately as before

On May 14, 1928, radiographically there was found healing in the bone defects of the skull, with development of many new defects

The patient did not return for further study until August, 1934, when roentgen study of the various areas of involvement indicated that there was practically normal bone structure (Figs 5 and 6) It was now recognized (L. A. S.) that the condition was Schüller-Christian's disease The ophthalmologic examination showed vision to be

O. D., 10/200, O. S., 20/20⁻² The eye-grounds appeared normal There was a crossed diplopia upward and to the right and a homonymous diplopia on the left with the left image higher in left oblique positions

The patient returned Nov. 16, 1934, upon request There was nothing new elicited in the history or physical examination at this time There had been no polyuria at any time The eye-grounds were studied again in view of the late findings in Schüller's first case, with normal findings The blood-count was essentially normal except for a slight anemia (12.5 g hemoglobin) Blood cholesterol was 173 mg per 100 c c of serum (method of Meyers and Wardell)

Comment—This patient's examinations and operations occurred before Rowland clarified the subject of xanthomatosis

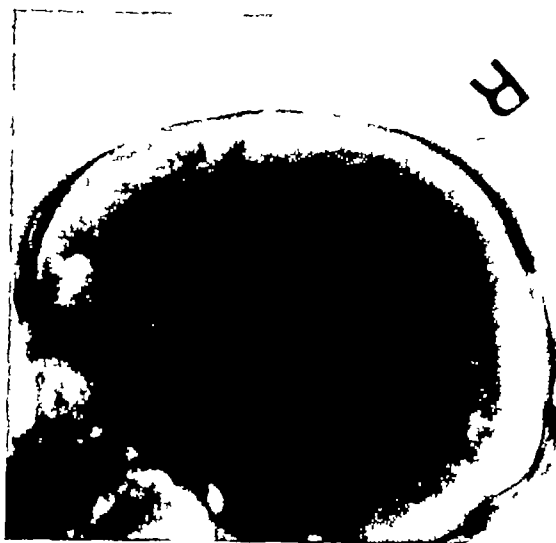


Fig 1 Case 1 Multiple defects in cranial bones



Fig 2 Case 1 Extensive defects in right ilium with much reactive osteosclerosis

aminations, the last two after provocative treatment. The von Pirquet skin test was negative.

Roentgen study (Aug 3, 1927), gave evidence of multiple areas of bone destruction in the skull, left scapula, left acromion, and right ilium (Figs 1 and 2). There was a "punched-out" appearance in the right fronto-parietal, left parietal, left parieto-occipital and lower occipital areas. A moderate amount of osteosclerosis surrounded the right fronto-parietal defect, and a considerable amount of osteosclerosis was present in the ilium. Irregular bone absorption occurred in the coracoid process, the neck of the scapula, and a portion adjacent to the articular surface. The bones about the right knee appeared negative. This was prior to Rowland's first communication discussing the xanthomatoses and the true condition was not recognized.

Between Aug 30 and Nov 14, 1927, areas in the left parietal, right and left temporal, left scapular and acromial, and the right iliac regions at the locations of palpable tumors and radiographically visualized bone defects were curetted, a hemorrhagic, yellowish, encephaloid mass being found at each. In the cranial operations this abnormal tissue was found lying be-

tween the periosteum and the dura. At the left parietal area two small lymph nodes external to the periosteum were removed which later gave histologic findings of interest. In the ilium a cyst-like cavity was found with a thin wall on the external aspect, the cavity filled with the tissue described plus about 20 c.c. of thin, straw-colored fluid. The outer wall here was easily crushed for approximate coaptation of walls.

A summary of the histologic findings follows (Figs 3 and 4). "There is a peculiar granulation tissue rich in large mononuclear cells (histiocytes) resembling those of benign giant-cell tumor rather than those of tuberculosis. Large areas of hemorrhage and necrosis are present. In some areas polymorphonuclear infiltration is the predominating feature, a large number of the polymorphonuclears being eosinophils. Clusters of hemosiderin granules are numerous and some of the macrophages are loaded with blood pigment. Yellowish bodies with doubly contoured walls, about 50 micra in diameter, are found in small numbers. In the lymph nodes there are found hyperemia and edema with marked proliferation of endothelial cells, also macrophages with blood pigment and areas of histiocytes

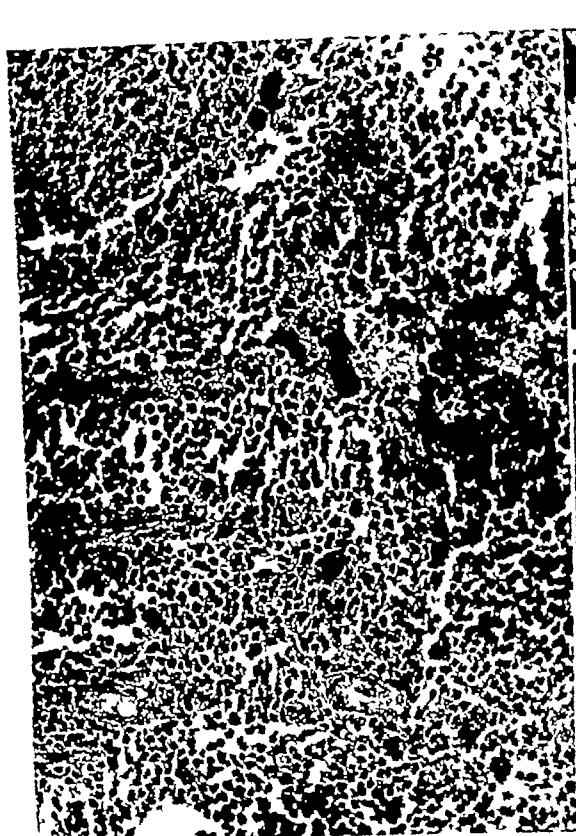


Fig 3 Case 1 Photomicrograph low magnification Hematoxylin-eosin stain Foam-cells not numerous, a frequent cause of error



Fig 4 Case 1 Photomicrograph, high magnification Sudan III stain brings out intracellular lipoids (This study was made subsequent to roentgen diagnosis)

and giant cells similar to those previously described "

Laboratory study in February, 1928, showed blood calcium to be 9.3 to 10.7 mg per 100 c.c. of blood serum (method of Clark and Collip). The red blood cells numbered 5,100,000 per cmm., white blood cells 12,860, with a differential count approximately as before.

On May 14, 1928, radiographically there was found healing in the bone defects of the skull, with development of many new defects.

The patient did not return for further study until August, 1934, when roentgen study of the various areas of involvement indicated that there was practically normal bone structure (Figs 5 and 6). It was now recognized (L. A. S.) that the condition was Schuller-Christian's disease. The ophthalmologic examination showed vision to be

O.D., 10/200, O.S., 20/20⁻². The eye-grounds appeared normal. There was a crossed diplopia upward and to the right and a homonymous diplopia on the left with the left image higher in left oblique positions.

The patient returned Nov. 16, 1934, upon request. There was nothing new elicited in the history or physical examination at this time. There had been no polyuria at any time. The eye-grounds were studied again in view of the late findings in Schuller's first case, with normal findings. The blood-count was essentially normal except for a slight anemia (12.5 g. hemoglobin). Blood cholesterol was 173 mg. per 100 c.c. of serum (method of Meyers and Wardell).

Comment—This patient's examinations and operations occurred before Rowland clarified the subject of xanthomatosis

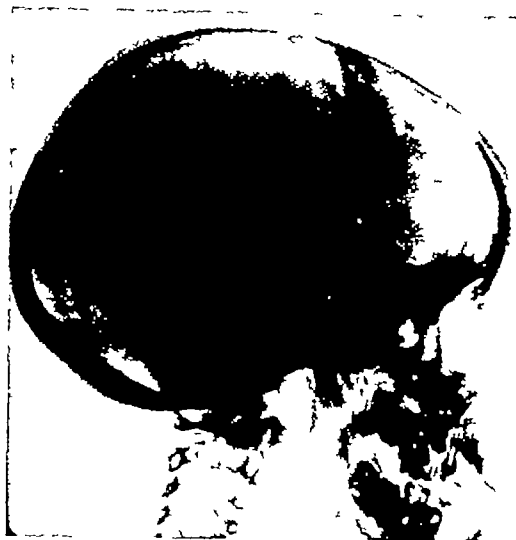


Fig 5 Case 1



Fig 6 Case 1 Complete absence of osteosclerosis seen in Figure 2

There was no familial history. An injury preceded the localization in the shoulder, but no element of trauma or infection could be elicited in connection with localization of changes in the other areas. The bone lesions did not resemble radiographically in their entirety those described in other cases, in that there was evident reactive osteosclerosis in places and some osteoporosis about one area in the skull. This osteosclerosis has now disappeared. Bone healing, while ultimately quite good, did not follow immediately after the surgical attacks. While the histological findings are rather characteristic of Schuller-Christian's disease, the diagnosis, although late, was ultimately made from the characteristic roentgen findings. The eye abnormalities have not improved in spite of the operative work and general improvement. The future course will be followed.

Case 2 The history of this case up to Oct 5, 1930, was reported by Mettel (38), therefore only the essential details will be presented here.

History—W P, R-950, aged 2 years 8 months, was first seen Nov 25, 1928, with the complaint of a swelling on the right side of the forehead.² This swelling appeared in

July, 1928, immediately after the head had been accidentally struck, and had continued during the intervening time. It was of rather soft consistency. The family history was irrelevant.

Examination—The child was well nourished and moderately well developed. General examination gave normal findings except for the cranial tumor. Over the right frontal bone there was an apparent defect 4 cm in diameter in the skull, with a bruit audible over it. Radiographs of the skull (Fig 7) gave evidence of a bone defect in the right frontal area, with some evidence of bone regeneration about the margins. No history had been sent with the requisition for examination. Study of the long bones and pelvis gave no evidence of any osseous lesion here and temporarily the diagnosis was left undetermined from the x-ray standpoint, but malignancy was suggested, or possibly syphilis.

Course—Anti-syphilitic treatment was of no benefit. On the diagnosis of probable hemangioma, radium was applied by Dr W H Kennedy between December, 1928, and December, 1929. Unfortunately, full details of radium dosage are not available. When seen on April 1, 1930, the lesion of the frontal bone had almost cleared clinically, but during the previous two months there

² Through a typographical error, the age was given in the original report as 5 years.



Fig 7 Case 2

Fig 8 Case 2

had developed at the junction of the left parietal and occipital bones a new area similar to the first, somewhat tender, about 3 cm in diameter. Radiographic study gave evidence that the original bone lesion was materially smaller, but some nine or ten new defects had appeared in various parts of the cranial walls, varying in size from about 1 to 10 cm in diameter, with lack of bone detail in the superior portion of the greater wing of right sphenoid and about the superior orbital fissure. The largest defect was in the left posterior parietal region just above the occipital bone. While the edges of the bony defects were for the most part sharply demarcated, there was a frayed appearance in some areas. On the basis of these radiographic findings we made in the roentgen department (L A S) a diagnosis of Schüller-Christian's disease and obtained further roentgen study April 29, 1930, finding no bone changes in the long bones, feet, ankles, or hands. The spine was not examined. There was pulmonary fibrosis of the type which had been previously described in Schüller-Christian's disease.

Except for word to Dr Mettel, Oct 5, 1930, that no new lesions had appeared and that the old occipito-parietal lesion was gradually disappearing, no further information regarding the patient was obtainable until August, 1934, on account of his having moved to another State.

When seen again for roentgen study on Aug 10, 1934, at the special request of Dr Mettel, there was almost complete bony healing in the areas previously involved (Fig 8). In the posterior portion of each parietal bone there was slightly less density than normal and a slight cranial deformity remained. The clinical condition was good, with no evidence of either old or new xanthomatous lesions. No further medical treatment had been followed.

Comment—The diagnosis was made here upon the roentgen findings, in spite of the normal blood cholesterol and absence of any of the symptoms of "Christian's triad," after the development of multiple bone lesions, Rowland's contribution having recently appeared. At that time less than twenty case reports could be found in the literature. There is nothing character-



Fig 5 Case 1



Fig 6 Case 1 Complete absence of osteosclerosis seen in Figure 2

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from which has classified it as a metastatic hypernephroma with xanthomatous changes (Bone Sarcoma Registry No 1832)

Comment—The occurrence of secondary xanthomatous changes in various bone tumors has been found in various conditions (2, 28, 30, 45, 48, 60) A single, primarily xanthomatous tumor such as this would be quite unusual, and the later histories of cases that have been reported as such should be carefully followed

Present Classification of Xanthomatosis—Rowland, Pick and others (19, 42, 52, 58) have discussed the historical background of these conditions and it will not be repeated here Since Rowland's important communications which have formed the basis for the present concept of lipid metabolic disturbances, extensive additions have been made to our knowledge of the general condition Rowland and many others have held that the essential process occurring in the primary xanthomatosis is a reticulo-endothelial storage in the sense of a phagocytic accumulation of substances occurring in unphysiologic concentration in the blood stream, these substances being cholesterol and its esters Pick disagrees with Rowland as to the reticulo-endothelial origin of the phagocytic cells concerned, contending that in Christian's disease, as in Niemann-Pick's, only the origin from reticulum cells and histiocytes of adventitia and perivascular connective tissues has been demonstrated While agreeing with the concept of a disturbance in lipid metabolism, subsequent investigators (16) have found that (1) Unphysiologic concentrations of cholesterol or cholesterol esters in the blood are sometimes, but not necessarily, associated with xanthomatous cell tumors or granulomas, (2) xanthomatous tissue changes may occur without increase of cholesterol in the blood, (3) while an accompanying hypercholesteremia may sometimes be favorably influenced by a prolonged dietary regimen, improvement of the pathologic tissue changes may not necessarily follow, and (4) the etiology of various forms or types of xanthomatosis is still to be determined The

lipoid occurring in Gaucher's cells is kerosin, in Schuller-Christian's disease chiefly cholesterol and its esters, and in Niemann-Pick's disease phosphatid lipoids or lecithin (16, 41) In Gaucher's disease no known changes occur in the chemistry of the blood In Schuller-Christian's and Niemann-Pick's diseases the blood cholesterol is often increased (16, 19) Michael and Nicholas (39) have given an extensive review of the blood chemistry in xanthomatosis

In connection with the third case discussed here we may note that in the localized xanthomas we may have (16, 41) (1) the non-neoplastic type as exemplified in the skin of the eyelids or about inflammatory conditions, (2) true neoplasms as represented by xanthomatous blastomas, sarcomas, or carcinomas We are told (16) that as a rule xanthomatous features are found only in these tumors which are located at the tendons or in the skin, but radiosensitive xanthomatous tumors have been found in the breast (17) and the characteristic foam cells of xanthoma have been found in tumors of the bone marrow apparently related to the so-called osteitis fibrosa cystica of von Recklinghausen (2, 26, 30, 45, 48, 60) Schroeder reports one case and discusses three others from the literature in which a xanthomatous giant-cell tumor involved a single bone Schrank and König have each found isolated xanthomatous bone tumors Knapp has reported two instances in each of which a xanthomatous tumor has involved only that portion of the frontal bone forming the roof of the orbit, each apparently cured by surgical excision In view of the occurrence in a case of Sosman's of an iliac lesion, very probably of a xanthomatous character, 5 years and 9 months after the first discovery of a cranial bony defect and 17 years after the development of diabetes insipidus, it remains a matter of conjecture whether such apparently localized bone defects as those mentioned above may not ultimately be followed by other bony lesions of like nature It is recognized that various types of tumors may undergo xanthomatous changes (Pick and others), but the investigators re-



Fig 9 Case 3 Photomicrograph high magnification Hematoxylin-eosin stain Many large, clear foam cells



Fig 10 Case 3

istic of xanthomatosis about the first bone defect shown, and no instance of radiographic recognition of such a single lesion has come to our attention. The reactive osteosclerosis here, as in Case 1, is atypical. The continued down-grade course after radiation therapy, with subsequent improvement, has been noted in other cases (23, 52). Presumably this patient has benefited greatly by reason of his radiation treatment, as have others with this condition. As in Case 1, the subsequent course cannot be foretold in view of other reported cases, but it would seem that the outlook is good.

Case 3 Mr. K., a white male, aged 69 years, consulted us March 13, 1934, because of a soft, moderately painful tumor over the lower part of the left scapula which had first appeared the previous August and which had been growing more rapidly in recent weeks. The opinion expressed by

two competent pathologists after histologic study of a biopsy specimen was that the condition was a primary xanthoma. Roentgen study gave evidence of an area of bone destruction in the wing of the scapula, 2.5 by 5.5 cm in diameter (Fig 10), with faint bony trabeculations extending outward from the plane of the wing of the scapula. The margins of the bony defect were rather sharply defined, with little or no evidence of any reactive process. No similar or other pertinent findings were obtained in other parts of the body, radiographically or clinically. The blood cholesterol was 172 mg per 100 cc, within the range of normal.

The lesion has proved radioresistant. While slow response to irradiation has been reported elsewhere in xanthomatous tumors (52), as in Schüller-Christian's disease, it seemed wise to submit the case to the Registry of Bone Sarcoma, a report

with the splenic anemias. It is on the average a more chronic type of disturbance of lipid metabolism and may occur at any age, although it usually begins in infancy. It is infrequent in occurrence, only 117 cases having been reported up to 1931 (42), and is associated with spleno-hepatomegaly, hemachromatosis, a hemorrhagic tendency, bone changes of unusual type, anemia, and frequently thrombocytopenia. It may run a very acute course or may last for many years with comparatively slight symptoms. The most important histologic feature is the Gaucher cell, which is diagnostic. Skeletal changes have in some instances become a prominent feature after splenectomy.

Histologic evidence of extensive skeletal involvement is frequent but radiologically demonstrable lesions seem to occur in only some 22 per cent of cases (42), as far as can be determined by the very incomplete data upon this point, although in one series of eleven, bone changes were found in six (58). No instances of Gaucher's disease with osseous lesions have come under our personal observation.

The skull is not often involved. Pick and others have reported the changes found. The femur may be the only bone with demonstrable changes in the early stage (42), in which case there is the frequent finding of areas of rarefaction of various sizes, in some instances with intervening sclerosis, giving a "worm-eaten" appearance. A club-shaped expansion of the lower third is so constant that it is considered by some (58) to be a diagnostic early roentgenologic sign and, in most instances recorded, the femoral neck and head have been the site of osteoporosis and irregular rarefaction and condensation which have permitted development of marked deformities. The other long bones have been the seat of similar changes. Histologically, the lesions have been found in practically every bone in the body. Involvement of epiphyseal areas have caused growth disturbances.

There has been at times a condensation and expansion of the bone. Thinning of

the cortex is common, due to exertion of mechanical pressure by reason of growth of the Gaucher cells. Pathologic fractures occur. Involvement of the vertebræ may be extensive, with resulting collapse of one or several bodies and consequent gibbus formation. The intervertebral discs are ordinarily intact. The literature upon these aspects has been reviewed by various writers (26, 42, and 58).

The differential diagnosis from the roentgen findings is simple if the characteristic changes are present in the lower femur. The true condition may well be suspected if the spine is the first part examined, but similar changes have been found in Schuller-Christian's disease. No other disease presents the same composite skeletal appearance, but in a case of non-lipoid histiocytosis (reticulo-endotheliosis) we have found a quite similar set of bone changes, there being cystic-appearing areas in one vertebral body and partial collapse of several bodies, with general rarefaction in the lower femora and upper tibiae. In this instance diagnosis was made from an excised lymph node. Tuberculosis of the spine differs in its characteristic destruction of the intervertebral disc and in the presence of an abscess, furthermore, there is very little hyperplastic bone repair in Gaucher's disease. Hodgkin's disease of bone may present a very similar roentgen appearance. Osteitis fibrosa cystica, Cooley's anemia, other lipoidoses, syphilis, tuberculous disease of the hip, the various deforming conditions of the hip and the anemia associated with osteopetrosis are readily differentiated if Gaucher's disease with its clinical symptoms is kept in mind. Histologic demonstration of the Gaucher cell is the final proof of the correct diagnosis.

Schuller-Christian's Disease—Schuller-Christian's disease has been variously termed "Christian's syndrome," "Hand-Schüller-Christian's disease," "generalized xanthomatosis," "lipoid granulomatosis," or "Hand's disease."

Symptoms of xanthomatosis of the Schuller-Christian type begin most frequently in the first decade of life, the age

porting the above-mentioned cases have considered that they were dealing with bone lesions primarily xanthomatous

Pick discusses an as yet unnamed subgroup among the class of essential non-symptomatic xanthomatoses which also represents a disease of the bones and which he considers may present a characteristic roentgen appearance. Only a few cases have been observed. The condition may occur in any age period or in either sex. As in Schüller-Christian's disease, a lipoid granulomatosis occurs in lipoid-containing cells which are widely distributed in the bone marrow all over the skeletal system. However, as contrasted with Schüller-Christian's disease, it is more evident in the diaphyses of the long bones than in the skull, the healing foci are delimited by bony trabeculae, and they are associated with an extensive osteosclerosis. Xanthomatosis of the skin or internal organs may be present or absent. The character of the deposited lipoids is not as yet fully known.

The foregoing applies to *lipoid* histiocytosis. In comparatively recent literature a condition of *non-lipoid* histiocytosis (9) has been delimited.

The following outline of the histiocytoses may then be formulated

Lipoid histiocytosis

(A) Primary or essential forms, constituting disease entities in themselves and based upon a constitutional anomaly of lipoid metabolism

- 1 Gaucher's disease
- 2 Niemann-Pick's disease
- 3 Hand-Schüller-Christian's disease
- 4 Various non-symptomatic external and internal xanthomatoses, including an unnamed group with characteristic bone changes, chiefly in the long bones
- 5 Exogenous, experimental cholesterosis (41)

(B) Secondary or symptomatic forms

- 1 Those occurring in disturbances of lipoid metabolism, especially in hepatic and diabetic conditions

2 Forms found in various granulomatous, sarcomatous, or carcinomatous tumors

Non-lipoid histiocytosis (also termed "reticulo-endotheliosis," "aleukemic reticulosis")

It is very doubtful whether the osseous forms can be considered as special nosological entities but from the roentgenologist's standpoint it is important to consider this group, since in many instances the xanthomatous cell proliferation is restricted to the organs of the hematopoietic system. The bony changes often are pathognomonic and the increasing number of reported cases of this type indicate a greater incidence than has hitherto been recognized, although these are not of frequent occurrence. They may well be considered among the bone diseases of childhood, since most of the radiographically demonstrated osseous lesions have been found in this age, chiefly in that condition known as the Hand-Schüller-Christian's disease, to which attention will be principally directed in this communication.

In the general non-symptomatic xanthomatoses, destructive or cystic bone changes may rarely be found (44).

Niemann-Pick's disease is associated with macroscopically visible bone alterations in only the very exceptional case. These consist of osteoporosis or a bone atrophy of quality (44).

The solitary xanthomatous tumor, with or without underlying or associated neoplastic changes of other nature, seems to have no characteristic roentgen appearance, except that it may present the same clear-cut bone defects which characterize the changes in Schüller-Christian's disease. It may have a cystic appearance (29, 47) and there may be a laminated periosteal reaction (29). There seems to be no constant syndrome of symptoms and the diagnosis rests ultimately upon the histologic findings. In such cases it is evident that errors will often occur by reason of the xanthomatous changes overshadowing the essential characteristics of the underlying tumor.

Gaucher's Disease — This has been classed

servation This patient at last observation was physically active, normally developed, and almost symptom-free In a few patients other than Schuller's the bone defects have undergone spontaneous retrogression (3, 13, 22, and 44) Between these limits there have been various gradations of severity of symptoms and length of course

The bone changes are usually those of absorption only, this being striking in degree and in numbers of areas involved Periosteal thickening is unusual but may occur (44)

Lazarewa tabulated the areas of bone involvement in 27 reported cases as follows

Skull	27 cases	100%
Sella turcica	5 cases	19
Maxilla	7 cases	26
Mandible	6 cases	22
Bones of pelvis (usually ilium)	14 cases	52
Vertebral column	3 cases	11
Ribs	4 cases	15
Scapula	1 case	4
Femur	7 cases	26
Humerus	3 cases	11

However, in many instances the skull has been the only part radiographed and, therefore, such statistics are of only relative accuracy

The most definite and characteristic bony changes occur usually in the skull, these having been found with great constancy in the reported cases Defects are found, involving both inner and outer plates usually, which may be only from 2 to 3 cm in diameter but which are often much more extensive than the palpable swellings and may affect the whole base of the skull They are multiple in the typical case or soon become so, giving rise to the now classical terms of "geographic skull" applied by Schuller and the "moth-eaten" appearance noted by Christian The margins are rather regular, sharply demarcated and with strikingly little reaction evident in the immediately adjacent bone, although there has been found a rarefaction zone close by (52) Some (5, 22, and 46) have reported marble-like osteosclerosis between the defects The bones of the anterior cranial fossa, the orbits, maxilla, and mandible are also often affected New defects may

appear while the old are healing, as occurred in one of Sosman's patients and in Case 2 of those presented here The petrous pyramid has in some instances been extensively absorbed

Next in frequency of involvement as compared with the skull are the pelvic bones, defects here varying from a scarcely discernible change up to marked deformities

Of the long bones, the femur is the most frequently affected There is a simple loss of substance with usually no evidence of osteosclerotic reparative reaction adjacent in those radiographs reproduced in case reports, except in quite isolated instances (5 and 57) In this connection the osteosclerosis present in the ilium of Case 1 of this communication is of interest and its replacement by normal bony structure later is most unusual The bones of the leg have been infrequently affected (1, 5, and 50), and those of the forearm even less often (50) Only one instance of tarsal disease seems to have been found (calcaneus) Otherwise the bones of the ankles, feet, wrists, and hands have apparently not shared in the gross absorption

Lesions of the vertebræ have been relatively less frequent and less extensive than in Gaucher's disease The body of a single vertebra has been found flattened (3, 46, and 55), and in one instance (46) rounded areas of destruction were found in the body of a cervical vertebra The latter has been found in non-lipoid histiocytosis by various observers including ourselves The intervertebral discs are ordinarily intact although Schotte found decrease in three spaces in the same patient

Pathologic fractures have occurred (3, 7, 19, 25, and 50) Bone healing of the usual defects may in time occur spontaneously or it may follow roentgen (7 and 52) or radium treatment (23), as in one of those herewith presented The lungs should always be studied radiographically, since healing of the xanthomatous deposits here tends strongly toward production of fibrosis, patchy or generalized

Differential diagnosis from the roentgen aspect in Schuller-Christian's disease is

limits of 1-7 years including a very considerable number of the cases summarized by Henschen and Vlavianos, as well as those reported since that time. A few older patients have been reported by Alberti (21 years), Kienbock and Selka (23 years), Chiari (26 years), Vlavianos (27 years), Seeliger (32 years), Hochstetter, Lyon, Gaál (38 years), Gaines (47 years), Gaucher's disease (?), and Sosman (55 years). The adult form of the Schuller-Christian-Rowland type, as distinguished from the Gaucher and strictly localized types, is thus seen to be rather rare.

The male sex is the more frequently affected in Schuller-Christian disease. In contrast to xanthomatosis in general (19, 57), there is no familial or racial predisposition indicated by recorded histories of patients with this type of lipoid disturbance, although Pick contradicts both of these views. He indicates that the Jewish race is more often affected than others.

The onset of symptoms in this type is often insidious, these often consisting at first of a tumefaction of rather soft consistency, which may or may not be tender on pressure. In this disease the lesions are found in the bones much more than in any other parts. The cranial bones have been involved in practically all of the cases, but the bony pelvis, femurs, maxilla, mandible, ribs, vertebrae, humerus, and scapula in descending order of frequency, have been reported as harboring the lesions. Clinical symptoms depend almost exclusively upon the anatomical parts affected and the consequent disturbances of physiology. Thus, two symptoms which led to its recognition as an entity in "Christian's triad" of defects in membranous bones, exophthalmos and diabetes insipidus, are recognized as depending upon involvement of the orbits and the hypophysis. The autopsy reports in various cases indicate that actual xanthomatous infiltration of the hypophysis is of great importance in relation to diabetes insipidus (6, 21, 31, 44, and 55), and it may be assumed that this is also the case in those patients showing retardation of growth or dystrophia adiposo-genitalis (41),

although there seems to have been no instances where a complete autopsy study of the endocrine glands has been made in this condition (19). Loss of teeth, deafness, discharging ears, pains in head, back and extremities, alterations of gait, optic neuritis, backward mental development and anemia are all thus similarly explained. Vlavianos' patient showed symptoms indicating the probability of cerebellar xanthomatous deposits. Special mention should be made of the strong tendency to fibrosis in the lungs, where this process of reaction and repair is more readily studied roentgenologically than in other vital organs. The lesions here have in a number of cases been the direct cause of death. Generally speaking, the subjective symptoms are strikingly slight considering the anatomic changes existing and the general condition may long remain quite good or may improve as a result of retrogression of these anatomic changes.

The onset of symptoms has been varied, acute in some, as in the first case reported (18) who suddenly developed diabetes insipidus, or insidiously with retardation of physical or mental development and occurrence of external cranial tumors, dental symptoms or pains in one or more parts of the body. The onset of the disease has in many instances followed an acute infection, general or local, and local trauma has appeared to be a factor in determining the location of many of the osseous lesions. The clinical course is likewise varied, in which respect it occupies an intermediate position between the related conditions of Niemann-Pick's disease, which always occurs in infancy and runs a very rapid course, and Gaucher's disease which may occur in infancy or, more frequently, in later childhood and which tends to run a chronic course over decades. The patient may die within the first year after onset of symptoms (18, 19, and 50). Others have been followed for periods of five years (15), six years (10, 14, and 22), and seventeen years (36 and 49), one of the last-named references reporting the first case observed by Schüller, the patient longest under ob-

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very greatly simplified in the well-marked case by the characteristic findings. Multiple myeloma, osteogenic sarcoma, metastases from the various malignancies, cystic bone disease, hemangioma, giant-cell tumor (especially in a vertebra), deforming osteochondritis of the spine, tuberculosis of the bone, non-lipoid histiocytosis, congenital syphilis or the early stages of osteitis deformans (osteoporosis circumscripta crani of Schuller) may conceivably enter into the differential diagnosis in the individual case. In Schuller-Christian's disease there is typically an absence of reaction in bone adjacent to the lesions. The distribution of bone lesions, presence of other evidences of disturbed lipid metabolism (possibly with high blood cholesterol), demonstration of one or more of Christian's triad of symptoms when present, or of other symptoms as noted will usually point to the diagnosis. Where possible, demonstration of the typical foam-cells in the histological specimen clinches the diagnosis in many instances, but histological study frequently fails to reveal the true condition (44).

Treatment of essential xanthomatosis in all its forms except the localized variety has accomplished only palliative results. Aside from symptomatic treatment, surgical excision of localized lesions, irradiation of local or general areas of involvement and restriction of fat intake, there is no therapy which seems directly helpful. Spontaneous retrogression often occurs. Previous reports upon radiation therapy have already been mentioned. Our first patient, however, improved after surgery without radiation treatment and is at present in good condition clinically. The discouraging preliminary response of Case 2 was followed by healing and lack of development of new defects, with a good general and skeletal condition persisting up to the present. The xanthomatous tumor in the elderly patient is improving slowly in that the size is reducing, new bone is appearing in the tumor substance and the movements of the part are less restricted. The slow local response here is no doubt due to the radioresistance of the underlying tumor, the lipid charac-

teristics being merely an associated feature which has confused the picture, as has no doubt been the case with some of the apparently primary single bone tumors which have been reported in the literature as being essentially xanthomatous.

SUMMARY

1 The case histories and roentgen findings of two patients with Schuller-Christian's disease and one with a metastatic hypernephroma associated with xanthomatous changes are presented with their roentgen findings. The latter exemplifies a condition not unusual but readily confused with bone tumors of simple xanthomatous nature, much more benign and of much rarer occurrence.

2 One of the Schüller-Christian cases presented a marked but temporary osteosclerosis surrounding one bone lesion, the entire area being later filled with normal bone. This is quite unusual in xanthomatosis.

3 Both cases of Schüller-Christian's disease now appear clinically well, one spontaneously after extensive operative treatment and the other after radium therapy.

4 The classification, roentgen findings, differential diagnosis and radiation therapy of the various xanthomatous lesions affecting bone are discussed and the literature reviewed.

5 The roentgen findings are often of greater importance in diagnosis than the histological, particularly in Schüller-Christian's disease after the earlier stages.

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THE TREATMENT OF HYPERTHYROIDISM BY ROENTGEN IRRADIATION OF THE PITUITARY GLAND

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I—HISTORICAL DEVELOPMENT OF THE PROCEDURE

RADIO THERAPY of the pituitary gland was introduced about twenty-five years ago for pituitary tumors (Gramegna, Bécélère, 1909). Since an improvement in gynecologic symptoms was frequently noted as a result of this form of treatment the trial was made of radiation of the pituitary gland in a whole series of gynecologic disorders (Hofbauer, 1922, Werner and Sahler, 1923). I myself reported in 1924 some observations which I made leading to the supposition that perhaps radiotherapy of the pituitary gland not only might favorably influence ovarian disorders but also might have a favorable effect on the symptoms due to hyperthyroidism. In 1924 I observed a patient who had an oligosymptomatic thyrotoxicosis and who was referred for radiation of the pituitary gland for amenorrhea. Four weeks after completion of treatment not only had the subjective symptoms all disappeared but the basal metabolic rate, which had been +35 per cent, had returned to normal. Even more interesting was a patient I observed with my colleague Kriser, who was treated by hypophyseal irradiation for a myoma. There was no effect on the myomatous bleeding, but many of the hyperthyrotic symptoms from which the patient suffered were improved very definitely, and also the patient's goiter decreased in size. I reported this last observation in a paper in 1925 on the interrelationship of the glands of internal secretion. In that same paper I mentioned a case of acromegaly that had a basal metabolic rate of +36 per cent before treatment, which decreased to normal by the

end of treatment and which subsequently showed no increase above normal.

Observations of this sort were very puzzling with our knowledge of the endocrine glands of that time, because in the texts on the endocrine glands the relationship of the thyroid and the pituitary glands was regarded as an antagonistic one and, according to this idea, there seemed to be no valid reason for suspecting that hyperthyrotic symptoms could be favorably influenced by radiation of the pituitary. For example, Biedl summed up the opinion of sixteen authors as follows: "The removal of the thyroid gland or the pathologic destruction of this gland in man is constantly followed by an increase in the size of the pituitary gland. The tissue changes are partly in the anterior lobe in which there is a hypertrophy of the chief cells and also a definite increase in the eosinophilic cells." Biedl also states, on the other hand, "Occasionally an acute hypertrophy of the thyroid gland occurs as a result of partial hypophysectomy." Similar observations were made in man. Hochenegg (1908) described a case in which, six months after extirpation of a pituitary adenoma, the thyroid of the patient, a woman 34 years old, with acromegaly, definitely enlarged. Exner also noted similar changes in a 34-year-old acromegalic patient. On the other hand, Kraus found in Basedow's disease that the hypophysis is small and of subnormal weight, the basophilic cells increased, and the eosinophilic cells decreased. These findings in experimental animals were confirmed by some effects of therapy in man. Teleky, Kumel and others state that they obtained improvement in some cases of acromegaly by the administration of thyroid tablets. Moreover, Pal

and Goldschneider state that they have produced improvement in cases of Basedow's disease by administration of pituitary extracts. In regard to radiation of the pituitary for symptoms associated with the climacteric, as carried out by workers both in this country [Austria] and abroad, I have made the observation that in those cases in which radiation of the pituitary produced no result oftentimes irradiation of the thyroid gland produced a favorable response. This observation also seemed to confirm the opinion that there is an antagonism between these two organs, so that an ovarian upset might influence one or the other of these organs to a more pronounced extent than the other.

On account of this wealth of observation and assertion in favor of an antagonism between the pituitary and thyroid glands, any synergistic relationship between them seemed hardly to be worth taking into consideration.

I myself would never have dared to draw any practical conclusions from all this evidence if the late Dozent H. Pollitzer, at that time assistant in Ortner's clinic, had not given his paper at the Wiener Gesellschaft für innere Medizin, in June, 1925, on "Exchange Reactions and Their Importance in the Pathology and the Indications for Treatment of Basedow's Disease." In this paper Pollitzer developed the conception that Basedow's disease is not an individual disease, but a syndrome, much as fever is, a complex of disturbances of various nerve centers, for example, the center for gas exchange, for cardiac stimulation and depression. These centers may be involved by disorders of the thyroid and of other organs. Since there is probably a psychogenic or genital Basedow's disease, Pollitzer says there is probably also a hypophyseal. The pituitary gland may secrete, as the thyroid does, an iodine-containing colloid which produces pathologic changes in the nerve centers just as does the secretion from the thyroid. The main characteristic of hypophyseal Basedow's disease is that thyroid changes are lacking, a high grade tremor that may even produce ataxia, a definite

gas exchange index found by multiplying the basal metabolic rate by the percentage specific-dynamic protein effect, and, finally, a lack of effect from iodine.

I took it as somewhat of a paradox that Pollitzer in these cases advised irradiation of the thyroid and not of the pituitary, as the latter procedure seemed to be the more plausible one theoretically. However, it was interesting that, according to the views of this celebrated internist, irradiation of the pituitary was logical in certain cases of hyperthyroidism. What seems more important though is that Pollitzer gave in this presentation some of the indications by which cases suitable for this treatment might be selected. Even though we were somewhat confused by the fact that radiation in two cases which Pollitzer regarded as hypophyseal did not produce a favorable result, still the idea of a hypophyseal Basedow's disease has persisted in the Holzknecht Institute, and has worked out practically, so that, in cases of hyperthyroidism in which irradiation of the thyroid has not produced the expected result, treatment of the pituitary is tried. And Holzknecht himself, as well as all of us, had a definite impression that hypophyseal irradiation really did produce a result in some cases in which irradiation of the thyroid previously had been without effect.

We most likely would have stayed in this period of uncertainty an even longer time if some publications about the subject had not given us definite reasons for changing our technical and practical concepts of the condition.

The first important disclosure was made in a paper of Juggenberg, from the State Roentgen Institute, in Leningrad, which appeared in 1930, and which was entitled "Unsere Methode der Röntgenbehandlung der Basedowkranken bei alten Frauen" (Our Methods of Treating Basedow's Disease in Old Women). The author had the impression that x-ray treatment of the thyroid in aged women with Basedow's disease gave poorer results than in younger women. She proposed the method of treating disorders of the climacteric by irradiation

tion of the pituitary or thyroid gland As has been mentioned, I had found that, in cases in which irradiation of the pituitary had produced no benefit, treatment of the thyroid had often produced a favorable result Juggenberg, therefore, carried out an analogous experiment on hyperthyroidism by an opposite procedure She had tried hypophyseal irradiation in cases in which irradiation of the thyroid had produced no result She reported the detailed histories of seven women in whom typical symptoms of Basedow's disease had come on, after the climacteric, treated in vain with medical means and by irradiation of the thyroid, who were markedly benefited by irradiation of the pituitary In two cases Juggenberg substantiates the therapeutic result by photographs of the patients, in the others by the basal metabolic rates and the other clinical findings These results might be surprising for one who had heard of them for the first time, but they were very convincing to others, such as myself, who had had an opportunity to make similar observations At a meeting of the International Congress of Physical Therapy, in Luttich, in September, 1930, at which the roentgen therapy of hyperthyroidism was discussed, I stated that my observations were in perfect accord with those of Juggenberg, with the reservation that I differed from her in the indications for the selection of cases I reported at that time on ten cases that had been treated by irradiation of the pituitary in the interval of the five years between 1925 and 1929 Of these ten cases, four had been markedly benefited over a period of years, while in the other six cases there was no definite change for the better

These practically unsatisfactory and theoretically obscure results took on a different aspect when I compared them with those reported by Juggenberg It appeared that in the case of the four women who were benefited by treatment, we were dealing with women in whom hyperthyrotic symptoms first came on during the climacteric, while the six unbenefited cases were all younger women The benefit from irradiation in women with hyperthyroidism at the

age of the climacteric and the failure in younger women was in part a confirmation and in part a supplement of the work of Juggenberg

This purely empirical stage in which the results were obtained accidentally was soon followed by one in which the indications for the selection of cases began to crystallize The third period began in the year 1932, when the therapeutic effects which, up to then had completely lacked any experimental explanation, were established on an experimental basis, and thereby were more readily understandable This explanation is due to a whole series of reports on animal experiments which have been great contributions to our knowledge of endocrinology and of biology

II — BIOLOGIC FOUNDATION OF THE PROCEDURE

In the year 1929, Loeb, an American, and Aron, in France, independent of each other, reported that a short time after the injection of extracts of the anterior lobe of the pituitary into guinea pigs there occurred a marked hypertrophy and hyperplasia of the thyroid gland to the extent that it could be seen even grossly If the intraperitoneal injections were made on five consecutive days, the weight of the thyroid gland doubled The first histologic changes could be appreciated about two hours after injection, and these started in the center and progressed toward the periphery The low cubical epithelium was replaced by a high cylindrical one The cells showed a great increase in mitotic figures, from about 100 to 40,000 They proliferated in the form of buds into the lumen of the acini The colloid lost its staining properties, and finally disappeared completely The thyroids of the animals which had received the injections of hypophyseal extracts underwent all the changes of an increasing proliferation, associated with a typical Basedow's disease of the thyroid in man Changes similar to those observed in guinea pigs were observed also in rats, mice, rabbits, cats, dogs, chickens, and ducks In all these animals the intensity was depend-

ent on the intensity of the stimulus, that is, on the number of the injections. The changes were reversible, in that they returned toward normal if the injections were stopped.

Janssen and Loeser showed that this was not a specific protein effect, because the thyroid did not undergo similar changes after the injection of milk or of tissue extracts.

By this work the existence of a real thyreotropic hormone in the anterior lobe of the pituitary gland was demonstrated with the same certainty with which a gonadotropic pituitary hormone had been demonstrated a short time before by other workers. It could be shown that the thyreotropic hormone is effective only when injected or implanted, not when it is given by mouth.

The changes in the thyroid occur after the extirpation of the cervical sympathetic, which shows that they are not produced by the agency of the nervous system. They may also even be demonstrated if the thyroid is severed from all its usual connections, and transplanted into another part of the body, such as the abdomen. This shows quite conclusively that these changes are produced through the blood stream. The effect of the hormone of the pituitary on the thyroid is not produced indirectly through the ovary for it occurs even in castrated animals. Aron demonstrated the presence of the thyreotropic hormone in the blood, the cerebrospinal fluid, and the urine.

Anderon and Collip succeeded in obtaining from the pituitary an extract which acted exclusively on the thyroid without the usual pituitary effect on the genital cells or on growth.

Jungmann and Scholler finally isolated the active substance from aqueous extracts. They showed that the thyreotropic pituitary hormone is easily soluble in water or in dilute alcohol. It is also soluble in very dilute acids and alkalis. It is, on the contrary, insoluble in concentrated alcohol, ether, chloroform and the other usual organic solvents. The substance is very

thermolabile, and is destroyed at a temperature of 60 degrees. The authors found that the chemical and physical properties of the thyreotropic hormone agree closely with those of the gonadotropic hormone and of insulin. The substance may be isolated by a special technic as a dry white powder.¹

By the recognition of the physical and chemical properties of this hormone another step in advance was made, whereupon one was in a position to investigate the question: To what extent are the anatomic changes in the thyroid gland accompanied by functional changes? In the thyroid Loeb, Loeser, and Grab found that the organic iodine decreased on an average from 13 to 1.3 milligrams per cent. On the other hand, the iodine content of the blood was definitely increased; it reached three times the value of normal blood iodine and five times the normal serum value. Substances nullifying the acetonitril poisoning reaction (the Red Hunt reaction) in white mice were markedly increased (Grab, Oehme). Smith found that the basal metabolic rate of the animals he treated with anterior lobe of the pituitary increased 30 per cent. Verzar found that it increased up to 50 per cent. Eitel and Loeser found a progressing exhaustion of glycogen from the liver which could be stopped, according to Loeser, by insulin or the administration of sugar, but not by administration of extracts of the pancreas. The same author, with Eitel and Löher, showed an enormous increase of the acetone bodies in the blood, from 10.5 to 22.2 milligrams per cent. Loeser also showed an increased activity of the heart and an increased consumption of food in the animals he had treated with the thyreotropic hormone. Of special interest is the observation, made first by Loeb and later by Eitel and Loeser, that guinea pigs which had been treated with anterior lobe of the pituitary developed a real exophthalmos which finding was subsequently obtained by Schockaert in ducks.

¹ The firm of Kahlbaum-Schering has already brought out this thyreotropic hormone.

If we review the experimental findings we can see that by the action of thyreotropic hormone, there results not only morphologic changes in the thyroid gland similar to those of the thyroid in Basedow's disease, but also the changes in metabolism and the other symptoms of hyperthyroidism characteristic of this disease. With all the certainty of an experiment the thyreotropic hormone of the anterior lobe of the pituitary produces the symptom-complex of hyperthyroidism and reproduces all the symptoms of Basedow's disease in man. By this a great step of progress has been made in the field of endocrinology, for now the answer to the questions of the relationships of the pituitary and the genital organs have been furnished. The pituitary, that tiny gland at the base of the brain, unstudied for a long time and in the investigation of whose function the Viennese school had such an important part (Erdheim, Aschner, Frolich and others), has now been shown by the work of American, French, and German investigators to be an organ with a number of extremely important secretory functions, particularly that of stimulating the other endocrine glands, especially the thyroid and the genital organs.

It is natural that after this stimulating effect of the anterior lobe of the hypophysis on the thyroid had been demonstrated, some therapeutic trials should be made on thyroid disease in which a stimulating effect on thyroid activity was desirable. This is the case with hypothyroidism. Such experiments were soon reported by Schittenhelm and Eisler, Eitel and Loeser, and Wachstein. It has been shown, at least by animal experiments, that it is possible to stimulate by means of the thyreotropic pituitary hormone a hypofunctioning thyroid to increased activity, in the same way that extracts which substitute for a thyroid deficiency act. A case treated by Wachstein in Eppinger's clinic may serve to illustrate the value of this new form of treatment. The patient was a woman 28 years old, who had had the classic symptoms of myxedema for two years, that is, she had pallor, thick

lips, dry roughened skin, disturbances of menstruation, persistent and resistant constipation, a basal metabolic rate of -28 per cent, and increasing apathy. She received injections for five days of the Schering-Kahlbaum thyreotropic hormone. Wachstein reported: "The improvement in the clinical picture was most surprising. The patient gained 5 kilograms in weight, the menstrual disturbances and the constipation were definitely improved. The patient's skin became soft and moist, the scaling of the nails stopped. A marked change took place in the woman's psychologic make-up. She took an interest in her surroundings, was much stronger and could work again."

Further experience will show to what extent this new form of treatment will work out practically, to what extent it may replace older forms of treatment or be combined with them. One of the disadvantages of this new form of treatment is that it is effective only in those cases in which there is still present thyroid tissue that can be stimulated to normal activity. It is valueless, therefore, in congenital and post-operative athyroses, and in those cases of hypothyroidism which are for all practical purposes cases of athyroidism because the thyroid in them is functionless. But even in these cases there is the possibility of making a differential diagnosis of hypofunctioning thyroid disease by means of the effectiveness or lack of effect of the thyreotropic pituitary hormone, because the "reaction to the thyreotropic hormone in cases of hypofunction of the thyroid may give definite information about the capabilities of the thyroid parenchyma" (Wachstein).

Just as substitution therapy in myxedema corresponds to resection therapy in Basedow's disease, the stimulation therapy of hypothyroidism by the thyreotropic hormone corresponds to reduction therapy in hyperthyroid disease by roentgen irradiation of the pituitary. Because of the difficulties of approach to the pituitary, operation on the pituitary in the treatment of hyperthyroidism has not reached

the same stage of development in the treatment of essential pituitary hypofunction that it has in the cases of diseases of the thyroid

On the other hand, there is an increasing mass of evidence of the value of radiotherapy in diseases of the pituitary which has been accumulating for almost a quarter of a century. Even though the deep position of the pituitary offered great difficulties at first in developing an effective radiotherapy, the technical progress in developing roentgen apparatus has brought us to the point that radiotherapy of the pituitary gland now presents no noteworthy difficulty. In the course of the past twenty-five years, we have become completely convinced of the absolute safety of irradiating the pituitary, because the brain surrounding the gland has been demonstrated both clinically and experimentally to be a tissue capable of tolerating with impunity even the strongest doses likely to be used in therapeutic procedures. I, myself, have in the course of ten years' experience carried out thousands of irradiations of the pituitary in hundreds of cases without ever having seen any evidence of any injury.

The indications for irradiating the pituitary are, in general, the same as for the thyroid. Hyperplastic and hyperfunctioning conditions are suitable for radiation. There are some contra-indications to the roentgen therapy of pituitary tumors, the commonest being the adenomas with or without symptoms of hyperfunction. A hyperfunction of the pituitary in the menopause which Holzknacht and I suggested in 1924 on the basis of the effect of radiating the pituitary in climacteric upsets, has been established as a definite field for radiotherapy by the demonstration of an excessive secretion of a follicle-maturing hormone by the pituitary after cessation of ovarian function in the menopause (Fluhman, Zondek, and others). Furthermore, Blas and Goldhammer have found that the increased secretion of this follicle-maturing hormone continues even after the disturbances of menstruation have been cleared

up by radiation. In the light of present knowledge it seems more logical to regard these upsets as due to an increased production of the thyreotropic hormone. It has been demonstrated by numerous experiments that an increased secretion of the thyreotropic hormone of the pituitary follows cessation of ovarian function. The first of the experimental evidence was produced by Aron, and subsequently confirmed by Loeser, showing that the pituitaries of castrated animals, both male and female, contain far more thyreotropic hormone than the pituitaries of non castrated animals. This has been shown to be true in the case of guinea pigs, chickens, and canary birds. The demonstration of an increased production of thyreotropic pituitary hormone after castration is a very important supplement to the older investigations, which showed, after castration, an increase in size and in weight of the glandular portion of the pituitary as a result of the increase in the eosinophilic cells (Fichera, Rössle and others). Similar changes have been noted not only in other varieties of animals but also in man. Windholz and the writer demonstrated similar changes in the pituitary after an intensive irradiation of the ovary.

The possibility of affecting the symptoms of hyperthyroidism by roentgen irradiation of the pituitary now is much more understandable if we keep in mind that one of the most certain properties of roentgen rays, which has been demonstrated by abundant clinical observations and animal experiments, is that of decreasing the secretory function of glandular organs.

In the light of this proven effectiveness of the roentgen rays as well as the demonstration of the relationship between the thyroid and the pituitary glands, we see the proposal to radiate the pituitary in certain cases of hyperthyroidism is justifiable from our knowledge gained both by animal experiment and by clinical observation. If these therapeutic experiments had not already been performed, they would nevertheless be justifiable on the basis of the animal experiments which

demonstrate a relationship between the pituitary and the thyroid glands. That clinical experience has preceded animal experiment and has produced noteworthy results, which later were shown to be those to be expected, is not surprising when we recall how frequently this sequence of events has occurred in other fields of medicine. By way of being fair, however, it must be admitted that in this case the results of radiotherapy were decisive and conclusive and that radiologic methods have shown their value not only in treatment but also in the field of research.

III—THE THERAPEUTIC RESULTS OF THE PROCEDURE

(A) Cases Treated with a Satisfactory Result by Irradiation of the Pituitary

Between 1925 and 1934 (an interval of ten years), we have carried out irradiation of the pituitary in 36 cases of hyperthyroidism: ten of these were treated between 1925 and 1929, the other 26 between 1930 and 1934. Table I shows the results that were obtained.

Period	No. Cases Treated	No. with Favorable Result
1925-1929	10	4 or 40%
1930-1934	26	21 or 80%
1925-1934	36	25 or 77%

The marked difference in results of the first and second five-year period is most readily explainable by the correct selection of cases, which was facilitated by the report of Juggenbergh, and secondly, by improvement in our technic of radiation, which we will discuss in detail later.

The increasing number of patients who reacted well resulted in a greater number of patients being referred for this form of treatment each year. It is hoped that the number of cases who have had pituitary irradiation with a good result will increase even more if the knowledge of the relationships between the pituitary and the thyroid, which are the actual biologic foundation for this treatment, is even more widely disseminated.

We may differentiate three groups of

cases which responded favorably to irradiation of the pituitary.

(1) *Cases which were treated primarily by radiation of the pituitary*—The following tabulation shows the results in this group.

No. Irradiated Cases	No. with Good Result
16	10 or 55 per cent

Among the ten cases with a satisfactory result, there were nine women in whom hyperthyroidism came on after the onset of the menopause. The two following case histories may serve to illustrate the course of cases which reacted favorably.

Case 1. P. S., 52 years old. Menopause at 48 years, since then, occasional hot flushes. For about four months, palpitation of the heart and sense of pressure in the chest. Frequent diarrhea, loss of 9 kilograms in weight, pulse 102, slight diffuse goiter, with bruit, blood pressure 160, basal metabolic rate +50 per cent.

Radiation of the pituitary from February 25 to 28 and from March 11 to 16, 1931. At the end of March, no more palpitation, gain of 1.5 kilograms in weight, pulse 90. In the course of a few months the patient returned to her former occupation. The body weight and the basal metabolic rate returned to their normal values. Without any further treatment, her condition has remained good until now (December, 1934), that is, for more than three and one-half years.

Case 2. P. F., 59 years old. Menopause ten years previously. After that, hot flushes, marked tremor, cardiac discomfort, frequent diarrhea. Pulse 132, basal metabolic rate +46 per cent. On May 28 and May 30, 1926, roentgen treatment of the pituitary. Since the patient felt better a week later, the treatments were repeated a few times. Further irradiation of the pituitary in October and November of the same year. Patient was very well pleased. The emotional instability, the cardiac discomfort and the general *malaise* had all disappeared. The pulse was better, but the basal rate was still increased to 35 per

cent Therefore, she received more treatment in February, 1927 Since the basal metabolic rate was normal in June, she was not treated further, and since then she has stayed practically free of symptoms for almost nine years Her metabolic rate has remained normal

The clinical course of these patients who reacted favorably to irradiation of the pituitary is exactly similar to the course in those cases in which irradiation of the thyroid was given with a satisfactory result The improvement goes in both types of treatment from the general to the particular, from the subjective symptoms to the objective signs The nervous symptoms, the irritability, the fatigability, sleeplessness, and headache improve first, then the body weight begins to increase and the basal metabolic rate to decrease Then there begins an improvement in the classic triad, so that the face of hyperthyroidism is the last to clear up The tachycardia, the goiter, and the exophthalmos disappear slowly and in some cases there is complete return to normal

The degree of improvement was very definite in our cases because the majority (seven) returned to about the same degree of physical efficiency which they had had before the onset of the disease Only three older women were unable to resume their work, but, at that, they were very much better than before the treatment

The metabolic rate, which was checked up in the nine improved cases, in six returned to normal values In three cases it persisted—a little elevated—but without causing any symptoms worthy of note, or severe enough to require further treatment Most of the cases regained the weight which they had lost The pulse rate generally returned to normal or persisted at only a slightly increased rate

The improvement has lasted in one of these cases less than a year, in four it has lasted more than two years, and in four, more than five years The oldest patient, treated in 1926, has remained subjectively free of symptoms and objectively almost free of any signs of the disease

It seems to me that the long duration of the effect is important, that is, the infrequency of relapse Among the ten cases that were favorably affected by irradiation of the pituitary, there was one patient who, a few months after completion of treatment, came back for more irradiation, but in this case it was the subjective symptoms alone which caused her to return An objective recurrence was demonstrated in a 50-year-old woman about a year and a half after treatment All the other cases have remained free of new symptoms during all the period of observation, that is, for two, three, five, and nine years In all these cases the duration of treatment was relatively short, usually two or three months The doses in most of these cases were about half what is usually used in direct treatment of the thyroid I shall return later to a consideration of the technical details of this treatment

(2) *Patients in whom irradiation of the thyroid failed and who were subsequently successfully treated by irradiation of the pituitary*—The following tabulation shows the results in this group

No Treated Cases	No Successfully Treated
12	9, or 75 per cent

Seven of the nine cases improved by irradiation of the pituitary were women in the climacteric

The two following case histories may serve to illustrate the course of the disease following irradiation of the thyroid and pituitary

Case 3 B K, 48 years old Operated on two years previously for a myoma, since then, amenorrhea Since April, 1932, loss of weight, palpitation of the heart, tremor, general weakness, diarrhea Since then, she has had medical treatment (quinin, arsenic, bromides, a diet, and about 30 short wave treatments) Since the symptoms progressed and the body weight continued to fall off, she was referred for irradiation of the thyroid, which

was carried out in January, 1933. Following that, there was a transitory improvement in her heart symptoms and in the tremor. In March her basal rate had increased. For this reason she received, in May and July, 1933, two series of three treatments of the pituitary. The patient's symptoms all cleared up. Her condition as checked up in October, 1934, still remains good.

The effect which the various methods of treatment had in her case is well illustrated by the basal metabolic determinations, done by Dr. Liebesny, in the Physikalisch-medizinische Abteilung des Wiener allgemeinen Krankenhauses. He had no knowledge of the change in treatment technique.

(a) Period of medical treatment (May-Dec 1932)			
1931	August 8, basal metabolism	62	8%
	September 7, basal metabolism	59	3%
1932	May 10, basal metabolism	60	%
	June 23, basal metabolism	57	3%
(b) Period of radiation of the thyroid (Jan-March, 1933)			
1933	January 13, basal metabolism	47	1%
	March 13, basal metabolism	59	8%
(c) Period of radiation of the pituitary (April-July, 1933)			
1933	July 20, basal metabolism	43	5%
	October 30, basal metabolism	25	5%
1934	March 9, basal metabolism	6	1%
	October 31, basal metabolism	2	0%

Case 4. Z. L., aged 44. Amenorrhea of a year's duration. Loss of 14 kilograms in six months. Lack of ambition. Loss of appetite. Anxious state. Palpitation of the heart. For many years she had had a diffuse goiter. Pulse 102. Marked tremor. Slight exophthalmos. Basal rate 50 (Dr. Güdemann). Three treatments of the thyroid in June and July, 1931. In spite of this and a vacation in the country a further loss of 4 kilograms in weight. Onset of diarrhea, increase of the tremors. Therefore, in September and October, three treatments of the pituitary. Condition at the end of October showed no further decrease in weight, felt better, had less palpitation and difficulty in breathing. Another treatment of the pituitary in November. In June the basal rate had increased to only 29 per cent. Patient had gained 5 kilograms, looks very well, and her symptoms are no longer annoying.

Pulse between 84 and 90. In December, 1933, a check-up showed the basal rate to be 20 per cent, pulse normal, and weight normal. In April, 1934, her basal rate was 19 per cent, pulse 78. Patient is fully capable of resuming normal activities.

The course of events in this group which reacted favorably agrees completely with that following irradiation of the pituitary, as a primary procedure. This is true also, apparently, in regard to the end-result. There is, for example, in this group a patient treated in 1925 by irradiation of the pituitary for thyroid disease, who has enjoyed good health for the ten years since then without any interruption whatever. If one reviews this group one gets the impression that these cases obtained the same result that they would have if they had been treated with pituitary radiation primarily. The patients noticed this themselves and often expressed this opinion. One of them expressed herself somewhat drastically but yet humorously, "To me, as a lay woman, it is quite puzzling that a disease which everyone knows is in my neck can be cured by treating my head. Can it be that the goiter which shows up in my neck is due to some defect in my head?"

The beneficial results in the cases in this group are more important than those in the first group, which were improved by irradiation of the pituitary and which show the fundamental effectiveness of pituitary irradiation, while the cases in the second group serve to emphasize the superiority of irradiation of the pituitary over treatment of the thyroid. The fact that cases which could not be improved by treatment of the thyroid could be improved by treatment of the pituitary, it seems to me, is one of the greatest advantages of this newer procedure.

(3) *Cases that were partly improved by irradiation both of the thyroid and of the pituitary*—The following tabulation shows the results in this group.

No Cases
Treated
8

No with
Favorable Results
6 or 75 per cent

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(B) *Cases in which Irradiation of the Pituitary Failed*

In the 36 cases that had irradiation of the pituitary, no results were obtained in 11 cases (23 per cent)

These cases may be classified as follows

Group 1 (primary pituitary irradiation) 16 cases	6 failures
Group 2 (hypophyseal irradiation after failure of thyroid irradiation) 12 cases	3 failures
Group 3 (pituitary irradiation after partial success with irradiation of the thyroid) 8 cases	2 failures

From a theoretical as well as practical point of view the cause of these failures is of much more interest than their numbers, for by the recognition of the cause it may well be possible to avoid similar failures or at least minimize them in the future

In some of these cases the cause for failure was undoubtedly too small doses. I will come back to this subject later on. Probably the main cause of failure was incorrect selection of cases for such treatment. In this regard we have a direct and indirect confirmation of the work of Juggenberg, for we demonstrated also that among the women who reacted poorly the great majority were in the climacteric, and among the cases that showed no result after irradiation of the pituitary, the greater part were youngish individuals. Among the 11 cases in whom irradiation of the pituitary had no effect, six women and one man were less than forty years old at the onset of their disease.

Of interest also is the fact that of six cases not favorably influenced by primary pituitary irradiation, two cases were later on practically cured by irradiation of the thyroid. If we take into consideration that in three other cases in Group 2 and in two cases in Group 3, irradiation of the pituitary, as has been mentioned, accomplished little more than had the irradiation of the thyroid, it appears that we are not in a position to state that pituitary irradiation is better than treatment of the thyroid, but that each type of treatment has its own special field in which its effectiveness is greatest.

This fact should be emphasized both for theoretical and for practical reasons, for the results of the animal experiments we have cited might give the impression that each case of hyperthyroidism is of a pituitary origin, and for that reason any method of treating the thyroid is beside the point. Such an idea should be emphatically rejected.

It is also clear that a well done resection of the thyroid, even though it is not the standard method, is still the most radical therapeutic method for the treatment of hyperthyroidism. And even though this procedure does not get at the cause of the disease, it leaves the organ, as has well been shown by animal experiment, incapable of developing a stage of hyperthyroidism. It, therefore, seems possible to modify or even suppress the development of hyperthyroidism by decreasing the activity of the thyroid gland by radiotherapeutic measures, but whereas the surgeon has to confine his efforts to the thyroid in the treatment of hyperthyroidism, because any operation on the pituitary is a much harder surgical procedure than operation on the thyroid, one can treat roentgenologically both the thyroid and the pituitary with comparatively little risk. If conditions are such that the thyroid is whipped up to increased activity by the pituitary, one will select the latter gland for radiologic treatment, and in those cases, especially in older women, in which after resection of the thyroid a recurrence has taken place, the thyroid will not be treated again, but the pituitary.

In those cases in which there is little evidence for suspecting an involvement of the pituitary, in addition to the thyroid, one will, naturally, irradiate only the thyroid.

Human hyperthyroidism, unlike experimental hyperthyroidism, is not always of a pituitary origin. In the human the noxious agent, perhaps through the nervous system, attacks the thyroid directly (Eppinger, Bauer and others). Against this idea the objection might be raised that there are inter-relationships between

Among the six patients who reacted favorably, there were three women in the climacteric. There was also one man in this group. The cases in this group are characterized by the fact that irradiation of the thyroid was effective in producing a favorable, and in some cases life-saving, effect, but to the point that further irradiation of the thyroid was unlikely to produce any improvement in the objective condition. Irradiation of the pituitary cleared up completely all residual signs of the disease.

Two illustrative case histories are given.

Case 5 O J, the patient, a man 50 years of age, had lost 20 kilograms in the past three years, most of it in the last three months. Marked weakness, marked tremor, cardiac symptoms, air hunger, exophthalmos, positive Mobius and Gräfe signs, enlargement of the right lobe of the thyroid, bruit, pulse 120, basal rate increased to 98 per cent.

Irradiation of the thyroid was administered from February to May, 1931. Following that, there was marked improvement. Patient left the hospital and went back to work part-time. However, in November of the same year the basal rate was still increased to about 50 per cent and the pulse varied around 100. These findings did not change after further irradiation of the thyroid, in November, 1931, and in January, 1932. On February 23 the basal rate was 48.9 per cent. Not until irradiation of the pituitary was carried out in September, 1932, was there a decrease of the basal rate to 25 per cent, and after that a decrease to normal values. Table II shows the figures of the basal rate.

(a) Period of irradiation of the thyroid (March 2 1931 to April 13, 1932)

1931	March 1	basal metabolic rate	98%
	November 17	basal metabolic rate	49.3%
1932	February 23	basal metabolic rate	48.9%
	April 2	basal metabolic rate	49%
	May 27	basal metabolic rate	41.9%
	September 10	basal metabolic rate	43.9%

(b) Period of irradiation of the pituitary (September 16 to 21 1932, July 7 to 23, 1934)

1932	December 2	basal metabolic rate	22.3%
1934	July 6	basal metabolic rate	25.5%
	September 1	basal metabolic rate	normal

Case 6 P R, aged 27 years. Onset of symptoms six months previously with headache, lassitude, loss of appetite, loss of weight, falling of the hair, enlargement of the thyroid, exophthalmos, delayed menstruation. Patient came for treatment in March, 1934. In spite of repeated treatment of the thyroid, improvement was slow only with great difficulty did we succeed in avoiding crises. Patient refused operation. Gradually we succeeded in getting her into better shape by a combination of climatotherapy and general medical measures. All symptoms improved. The basal rate which had been 73 per cent, decreased, but the patient had to receive further radiotherapy because the basal rate started to rise again, from its normal value. When it had gotten up to 26.7 per cent in November, 1932, irradiation of the pituitary was carried out. After the first treatment in November the basal rate was unchanged, as it was in January, 1933, but in March it went down to 7 per cent, in December, 1934, it was 2.5 per cent—in other words, it persisted at a normal level.

In this group there were two recurrences. These were manifest not in the clinical symptoms but in the basal rate. After it had been brought down by irradiation of the thyroid and had remained at a certain level and after a second drop had been produced by irradiation of the pituitary so that it was practically normal in both these cases, it rose again to about the same point at which it was before irradiation of the pituitary.

Summing up, one may say, of 36 cases that were treated for hyperthyroidism either primarily by irradiation of the pituitary or by pituitary irradiation after irradiation of the thyroid had produced a poor result or only a partial one, 25 cases (77 per cent) were favorably influenced. These results have lasted for years in most cases. They were obtained by lower doses and in less time than they could have been obtained in the average case by irradiation of the thyroid.

the apparent discrepancy between the old and the new studies on the relationships between the thyroid and the pituitary. The older studies, as has been mentioned, seemed to show an antagonism between them, while the more recent investigations seem to show a synergistic relationship between them. These contradictory conclusions are the result of the fact that in earlier times it was easier to perform an extirpation of the thyroid than of the pituitary, which excluded, therefore, comparable studies on this organ. These experiments on the thyroid seemed to point to a stimulating effect on the pituitary, so it was concluded that hyperfunction of the thyroid resulted in a hypo-activity of the pituitary. But in later times, when the surgical technic of hypophysectomy had become more perfected and the effect of the pituitary on the thyroid more carefully studied, it appeared, to the contrary, that an atrophy and not a hypertrophy of the thyroid resulted. Then finally, when the pituitary hormone were isolated, it was found that among its properties was one which stimulated the function of the thyroid. As applied to human pathology, these findings lead to the following results.

If some noxious agent arises in the thyroid, there results from the hyperactivity of the thyroid a decrease in the activity of the pituitary, in which case roentgen irradiation of the pituitary is strictly contraindicated. There is the same contraindication if the thyroid disorder, through over-production of toxins, results in some ovarian damage or upset. In this case the tendency to over-production of thyreotropic hormone caused by the suppression of ovarian activity opposes the suppression of pituitary activity caused by the hyperactive thyroid. The increased activity of the thyroid can be suppressed in such a case by operative reduction of the size of the gland or a radiotherapeutic reduction of its function.

If, on the other hand, the noxious agent arises in the pituitary and by it there results an over-production of thyreotropic hormone, or hyperactivity of the pituitary,

then in this case an operation on or a radiation of the thyroid is hardly indicated, but radiation of the pituitary, as it attacks the physiologic etiology of the trouble.

It is of the greatest importance that the two groups can be kept distinct without any extensive investigation merely by establishing the age of the patient and by taking an accurate clinical history. If the patient is a young one, we are dealing with a primarily thyreogenic case, if, on the other hand, the patient is older and the hyperthyroidism began with the menopause, we are dealing with a primary pituitary and secondary thyreogenic case. It is quite important in the human to distinguish the two types of hyperthyroidism, a state of affairs that does not exist in the case of animal experiments.

Another point is useful in distinguishing spontaneous hyperthyroidism in man from experimental hyperthyroidism in animals. In animals, hyperthyroidism can be brought on experimentally in every case, but hyperthyroidism occurs in man in only a low percentage of cases. This fact is not very strange when we remember that there are great differences between the two types of animals. Thus Loeb has found that the thyroids of guinea pigs react less intensively after the administration of thyreotropic hormone than do the thyroids of rats. There are differences between various individuals just as there are differences between various kinds of animals. This fact can be explained only on the basis of the ideas of Chvostek, J. Bauer, and Eppinger, that there is a constitutional disposition to some diseases. It so works out, therefore, that whether hyperthyroidism occurs in a person or not depends on the inter-relationship and balance of his various organs and tissues.

In regard to the influence of the constitution on the course of the disease there is another noteworthy difference between man and animals. In animal experiments, the course and development of hyperthyroidism is quite uniform, in man, on the other hand, hyperthyroidism is different in different patients, because different

the glands of internal secretion, which may reciprocally increase the activity of these glands, or decrease them. Since it has been shown that an increased activity of the pituitary results in an increased activity of the thyroid, one might postulate that, *vice versa*, hyperactivity of the thyroid should lead to increased activity of the pituitary, then the damaging agent arising in the thyroid affects the pituitary secondarily and involves it in hyperthyroidism. This is not the case, however. One of the theoretical and practical results of the modern study of endocrinology is that these inter-relationships of the endocrines do not always supplement each other, but may often, on the contrary, oppose each other. According to this idea the pituitary is a motor of the sexual function and a stimulus of the thyroid functions. The reverse does not hold true. It has been established for a long time that the genital glands suppress the activity of the pituitary. The same function has been reported for the thyroid by Loeb, who started with the well-known fact that after resection of the thyroid the portion remaining undergoes a compensatory hypertrophy. But a hypertrophy does not take place if, after resection, the animal is given thyroid extracts. Loeb concluded, therefore, that the secretion of the thyroid had among its various functions that of holding the secretion of the organ constant at a certain level. If the thyroid is producing less hormone as a result of resection, the activity of the gland is stimulated by the lack of hormone and the gland hypertrophies. If, however, thyroid is administered, there is no need for hypertrophy and it does not occur. Another thing associated with the regulation of the thyroid activity by its own secretion was discovered by Loeb, namely, that the action of the anterior lobe of the pituitary on the thyroid is less, or may even be absent entirely, if thyroid extracts are given. From these interesting observations it seems that, whereas the thyreotropic and the thyreogenous hormone effect peripheral tissues in the same way, they

have an opposing action on the thyroid—the thyreotropic hormone stimulates, the thyreogenous hormone depresses the thyroid.²

Of special interest in the mechanism by which the thyreogenous hormone exerts its depressant effect on the thyroid, Kuszinsky showed that the depressant effect of the thyroid hormone results through the agency of the pituitary, and that the thyroid hormone decreases primarily the activity of the pituitary. This was demonstrated in the following way. The thyroid of a guinea pig was activated by transplantation of pituitary tissue from rats. If the rats were previously treated with thyroid, the thyroid-stimulating action of their pituitaries was lacking. The pituitary of animals to which thyroid substance had been given, therefore, produced no thyreotropic hormone, or at least a greatly decreased amount, compared with the pituitary of a normal animal.

There seems, therefore, to be the same relationship between the pituitary and the thyroid as between the pituitary and the genital cells, for the administration of folliculin depresses the formation of prolan just as the administration of thyroid substance hinders the production of thyreotropic hormone. On the other hand, administration of prolan accelerated the production of folliculin in the ovary, just as administration of thyreotropic hormone stimulates thyroid activity.

These interesting experiments explain

² Many well known facts seem to confirm this idea. In Trendelenburg we find the following: After administration of thyroxin or of thyroid the thyroids of mammals in general are smaller, denser, more anemic; the colloid is increased, stains well; the epithelial cells are flatter; the number of mitoses is decreased; there is degeneration of the epithelium; disappearance of the follicles and the formation of colloid cysts. If dogs whose thyroids show epithelial hyperplasia are given thyroid there occurs after a short time a transformation of the hyperplastic gland into a colloid gland. The increased height of the acinar epithelium and the decrease of colloid content and the compensatory hyperplasia, the increase in mitoses, and lack of colloid seen after partial removal of the gland are lacking. The follicles are in a resting state, that is the epithelium is flat; the number of mitoses is low and the colloid is viscous. (Vol II page 165)

the apparent discrepancy between the old and the new studies on the relationships between the thyroid and the pituitary. The older studies, as has been mentioned, seemed to show an antagonism between them, while the more recent investigations seem to show a synergistic relationship between them. These contradictory conclusions are the result of the fact that in earlier times it was easier to perform an extirpation of the thyroid than of the pituitary, which excluded, therefore, comparable studies on this organ. These experiments on the thyroid seemed to point to a stimulating effect on the pituitary, so it was concluded that hyperfunction of the thyroid resulted in a hypo-activity of the pituitary. But in later times, when the surgical technic of hypophysectomy had become more perfected and the effect of the pituitary on the thyroid more carefully studied, it appeared, to the contrary, that an atrophy and not a hypertrophy of the thyroid resulted. Then finally, when the pituitary hormone were isolated, it was found that among its properties was one which stimulated the function of the thyroid. As applied to human pathology, these findings lead to the following results.

If some noxious agent arises in the thyroid, there results from the hyperactivity of the thyroid a decrease in the activity of the pituitary, in which case roentgen irradiation of the pituitary is strictly contraindicated. There is the same contraindication if the thyroid disorder, through over-production of toxins, results in some ovarian damage or upset. In this case the tendency to over-production of thyrotropic hormone caused by the suppression of ovarian activity opposes the suppression of pituitary activity caused by the hyperactive thyroid. The increased activity of the thyroid can be suppressed in such a case by operative reduction of the size of the gland or a radiotherapeutic reduction of its function.

If, on the other hand, the noxious agent arises in the pituitary and by it there results an over-production of thyrotropic hormone, or hyperactivity of the pituitary,

then in this case an operation on or a radiation of the thyroid is hardly indicated, but radiation of the pituitary, as it attacks the physiologic etiology of the trouble.

It is of the greatest importance that the two groups can be kept distinct without any extensive investigation merely by establishing the age of the patient and by taking an accurate clinical history. If the patient is a young one, we are dealing with a primarily thyreogenic case, if, on the other hand, the patient is older and the hyperthyroidism began with the menopause, we are dealing with a primary pituitary and secondary thyrogenic case. It is quite important in the human to distinguish the two types of hyperthyroidism, a state of affairs that does not exist in the case of animal experiments.

Another point is useful in distinguishing spontaneous hyperthyroidism in man from experimental hyperthyroidism in animals. In animals, hyperthyroidism can be brought on experimentally in every case, but hyperthyroidism occurs in man in only a low percentage of cases. This fact is not very strange when we remember that there are great differences between the two types of animals. Thus Loeb has found that the thyroids of guinea pigs react less intensively after the administration of thyrotropic hormone than do the thyroids of rats. There are differences between various individuals just as there are differences between various kinds of animals. This fact can be explained only on the basis of the ideas of Chvostek, J. Bauer, and Eppinger, that there is a constitutional disposition to some diseases. It so works out, therefore, that whether hyperthyroidism occurs in a person or not depends on the inter-relationship and balance of his various organs and tissues.

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symptoms result from differences in reactivity to the same stimulus, so that there results a varying intensity of the separate symptoms which go to make up the varying symptom-complex of hyperthyroidism

One more difference between experimental and human hyperthyroidism should be mentioned. It is a fact that certain symptoms which occur regularly, or, at least, frequently, in spontaneous hyperthyroidism, and which are characteristic of the disease, are either lacking completely in experimental hyperthyroidism (such as, for example, loss of weight and diarrhea), or are less marked (for example, tachycardia). This deviation warns us that we must be extremely careful in applying the findings in one type of animal to another, or from animal to man, and especially in applying them from one human being to another. Animal experimentation serves only to reproduce under exact conditions some of the phases of a disease in question so that some of its relationships may be understood more exactly. With such a point of view we have considered the favorable effect of roentgen radiation of the pituitary on hyperthyroidism. The animal experiments of the past few years have served to clarify that which we knew empirically was true in man. In the case of man, we knew the head and tail, and animal experiments found for us the body.

(C) Apparent Exceptions and Obscure Cases

Among the 23 cases in which pituitary irradiation produced a favorable result, there were six in which the otherwise valid indications by which radiation of the pituitary in women in the climacteric with hyperthyroidism was effective and in younger persons ineffective, no longer held true.

One exception to this rule which seemed to be well established biologically is that of sex. We have, as has been mentioned, observed a man (Case 5), 50 years old, in whom irradiation of the thyroid was a life-saving measure, it is true, but in whom the

basal metabolic rate established itself at about 40 per cent in spite of repeated irradiation of the thyroid. Radiation of the pituitary at this stage produced an uncontrovertible drop of the basal rate to normal. From this, we might draw the conclusion that radiation of the pituitary should not be reserved for old women, but that old men should be included. Here, further experience is very desirable.

Two other cases were exceptions from the standpoint of age. One woman was 35 at the onset of her disease, the other 27 years old. In the first patient the state of affairs is a bit clearer than in the second case, because in the former menstruation was absent during the period in which irradiation of the thyroid produced no result whatever. When irradiation of the pituitary was started for this reason her menstruation began again, and there followed a slow but definite improvement in her hyperthyroid symptoms which has lasted more than five years. Conditions are more obscure in the second patient whose history is given under Case 6 above. In this case irradiation of the thyroid had had sort of a half satisfying effect. The basal metabolic rate did not return to normal until four years after the beginning of radiotherapy. In three months it rose again. During the whole time the patient menstruated regularly at somewhat longer intervals than normal and the flow was decreased in amount. Whereas in several other similar cases irradiation of the pituitary had had no definite effect, in this case the recidivity was promptly cleared up by irradiating the pituitary, and her general condition has remained quite satisfactory for more than four years. The two cases, however, have much in common—the long duration of the disease. The first case, 35 years old at the time roentgen therapy was given her, had already been suffering from a definite Basedow's disease for three years and had had ligation of the thyroid arteries. In the second case it took roentgen therapy almost three years to produce a result before radiation of the pituitary was carried out. Perhaps, there-

fore, in long-standing disease there occurs a change in the pituitary of young individuals also, which may explain the favorable effect of radiating the pituitary. In this regard, further experiment and experience are very desirable.

Three other young women were benefited by irradiation of the pituitary without there being any reasonable explanation for it. The patients all menstruated, perhaps less profusely and more irregularly than before the onset of the disease. In these cases the disease had been present for only a few months. Without being able to prove it, we might adopt the explanation that they were not improved by irradiating the pituitary but by the climatothrapy and the medical means with which they were treated. These points need further investigation.

IV —THE TECHNICAL ASPECTS

Since the anatomic structure of the anterior lobe of the pituitary is similar to that of the thyroid, we have irradiated the hyperactive pituitary in the same way we treat a hyperactive thyroid. I have described the technic in detail in the presentation I made at Luttich in 1930. We treat the thyroid through an anterior and two lateral fields at two-day intervals. In the same way the pituitary is treated through

a frontal and two temporal fields. The dose on the skin, as it is in the case of the thyroid, is 200 r. Because of the fact that the thyroid is quite superficial and the pituitary is located at a depth of 7 cm on the average, and so the effective dose is only about 40 per cent of that effective in the skin, the three fields are treated for a second time after eight days. The other treatment factors are 0.5 mm zinc filter, 30 cm distance, 170 kilovolts.

In about 50 per cent of the cases irradiation carried out in this way has produced a satisfactory result. There is no doubt that the dose effective in the pituitary is definitely lower than that which is usually effective in the treatment of diseases of the thyroid.

If the basal metabolic rate or the pulse deviate greatly from normal at the end of eight weeks, we repeat the radiation series. We have given a third series only in case of recurrence.

Aside from headache, which occurs now and then on the day of treatment, we have never seen any upset from irradiation of the pituitary. This agrees perfectly with what has happened in the thousands of pituitary treatments which I have given for various reasons to hundreds of patients during the last ten years. This roentgenologic technic is perfectly safe and without any danger whatever.

THE RÔLE OF THE FORCE OF GRAVITY IN THE PNEUMOTHORAX CAVITY

INCLUDING A DISCUSSION OF SELECTIVE COLLAPSE¹

By EPHRAIM KOROL, M D , Veterans' Administration Facility, Lincoln, Nebraska

IN THE normally expanded lung, the apex is partly relieved of the weight of the lung base by the expansibility of the numerous air vesicles which are in communication with the atmosphere. Traction on the lung at any one point is immediately satisfied by the rush of air from the outside (1). Furthermore, the atmospheric pressure holds the lung against the chest wall, counteracting the pull of gravity. In the upright position, the pull exerted on the apex by the weight of the lung is but two centimeters of water greater than at the diaphragm (2). If the lung is separated from the chest wall by the entrance of air into the pleural cavity, the force of gravity is given full play. The lung drops by its weight and sinks downward and inward as far as its attachments at the hilum will permit. The several lobes, being fixed to the bronchi, which vary in length and direction, separate out and drop away from each other. The lobes, normally indistinguishable from each other, become plainly visible on x-ray films taken after the induction of a pneumothorax. The interlobar fissures are wide open, and the incidence of pleural exudate and of spontaneous pneumothorax is greater in cases treated by artificial pneumothorax than in cases not so treated.

The partly collapsed lung is freely movable, and during changes of posture shifts around much like the clapper of a bell, to use the apt simile of Rist (3). Upon changing from the recumbent to the erect position, the lung may be felt to strike against the palpating hand. By percussing in the different positions of the body, areas of shifting dullness are found, so that hydropneumothorax is simulated (4). In the recumbent position, no breath sounds

can be heard over the front of the chest, while in the erect position harsh breath sounds appear.

If the collapsed lung be adherent to the chest at one or more points, then the freely movable portion of the lung tugs on the adhesions, particularly during forced respiration or physical exertion, and during changes of posture, thus bringing about enlargement of cavities, tears in the lung, and torsion of blood vessels. The traction on the adherent lung is greater if the adhesions involve the mediastinum or the diaphragm, as the weight of the heart and of the abdominal viscera is added to the weight of the lung.

Massive Atelectasis in the Pneumothorax Lung—The pull of the dangling lung is exerted chiefly on the large bronchi, particularly on the bronchus of the upper lobe which is pulled downward and inward, away from its natural course. The upper lobe bronchus is not infrequently linked to such an extent that its lumen is occluded and the entire lobe becomes atelectatic (Fig 1). This is more likely to happen if the lung contains a pneumonic area or a cavity holding pus or blood, rendering the lung heavier than usual. The left upper lobe is more vulnerable in this respect as it is equal in weight to the right upper and middle lobes combined, but is supported by a single bronchus.

In cases of bronchial occlusion and atelectasis of this nature, there usually develops fever, unproductive cough, and general malaise, all being symptoms of retained secretions. On physical examination we have observed an area of tubular breathing between the spine and the scapula, on the treated side. The roentgenogram discloses a completely airless lobe, which appears very opaque, in marked contrast with the other partly inflated lobes suspended in the pneumothorax.

¹ Published with the permission of the Medical Director of the Veterans' Administration who is not responsible for the conclusions drawn or the opinions expressed by the author.



Bilateral pneumothorax A massive atelectasis of the left upper lobe, the left lower lobe is air-bearing and can be seen both above and below the limits of the upper lobe, which has contracted toward the hilum

Fig 1-A Roentgenogram taken with the patient standing. The lungs have dropped downward and inward and rest on the diaphragm. There is an adherent cavity in the right apex

Fig 1-B Roentgenogram taken with the patient lying on the right side—film made at the same sitting as in Figure 1-A. On the right side the air has risen toward the mediastinal region and is invisible. On the left side, the lung has shifted apicalward, displacing the air toward the diaphragm

Fig 1-C Roentgenogram taken with the patient lying on his left side. The left lung is now at the bottom of the pleural cavity, the air is in the apical and mediastinal regions. The right lung has moved upward, displacing the air toward the diaphragm. The outlines of the lower lobe are reinforced with pencil

What is the fate of the atelectatic lobe, and what bearing has this complication on the result of the treatment? Steiger (5), who describes three such cases, states that the atelectatic lobe undergoes fibrosis and prevents the re-expansion of the lung at the termination of the therapeutic pneumothorax. Surgical collapse measures have to be employed in order to bring the chest wall in contact with the crippled lung. In a case described by Wang and Van Allen in the April, 1934, issue of this journal, the atelectatic right upper lobe failed to expand after the pneumothorax was abandoned. Following a phrenicotomy the middle and lower lobes filled the entire hemithorax. De Winter and Sebrechts (6) described a case treated by bilateral pneumothorax in which both upper lobes became atelectatic; the patient recovered and the upper lobes re-expanded. It has been my observation that the bronchial lumen may be re-established in these cases. After the pneumothorax has become complete and the blood and mucus have been expressed from the treated

lung, the weight of the lung is much reduced, the strain is removed from the kinked bronchus and its lumen becomes patent again.

Obstructive Emphysema in the Pneumothorax Lung—If the bronchus be twisted but its lumen not completely obliterated, the stenosis may act in a ball-valve manner, leading to obstructive emphysema and to enlargement of cavities in the affected lung. In such cases it may prove difficult to maintain the pneumothorax even by large and frequent inflations—the “pneumothorax insatiable” of the French writers (7). Emphysematous blebs are commonly seen in the pneumothorax lung, and have been described during bronchoscopic observations as well as during postmortem examination (8 and 9). Occasionally these blebs have ruptured into the pneumothorax cavity (10).

Enlargement of Cavities in the Pneumothorax Lung—Many observers have reported the enlargement of cavities after the institution of pneumothorax treatment. Siems (11) observed the annular shadows, both of emphysema and of

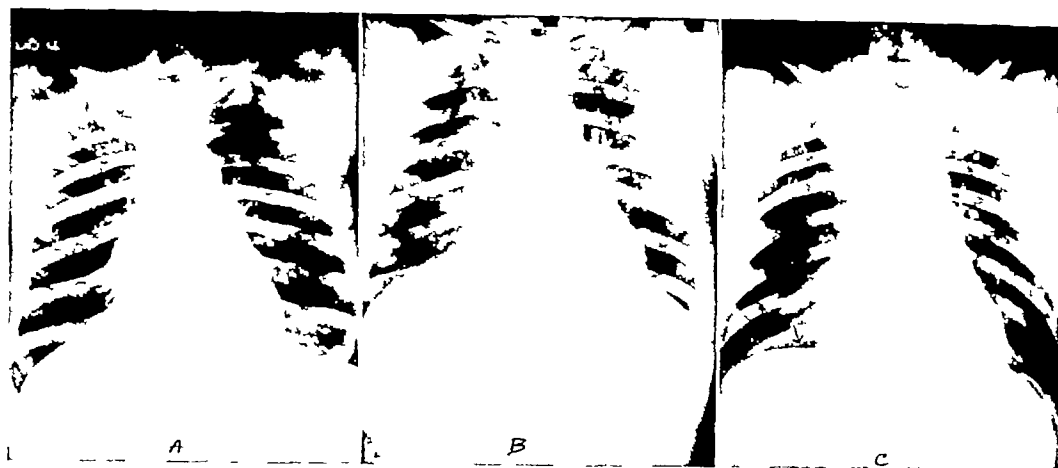


Fig 2 A Roentgenogram taken just prior to induction of pneumothorax. There is extensive tuberculosis in the right upper lobe—no cavity is visible.

Fig 2-B Roentgenogram taken after inflation of 500 c.c. of air with the patient sitting. The lung has dropped downward and inward. There is a large cavity opposite the first anterior interspace. The lung rests on the diaphragm; there is air in the apical region.

Fig 2 C Roentgenogram taken same day as Figure 2 B with the patient lying on his face—the foot of the bed is elevated 6 inches. The lung has moved toward the apex; there is no cavity discernible. There is air above the diaphragm.

tuberculosis, to first appear or to enlarge after the induction of pneumothorax. He is inclined to believe that the enlargement is more apparent than real, and might be explained by the altered radiability of the chest contents after the inflation of air. He admits, however, that kinking of the draining bronchus may be a factor.

Alexander (12) thinks that the x-ray appearance of the line of demarcation is altered but that there is no actual enlargement of the cavity in these cases. In Slavin's (13) cases, the cavities admittedly enlarged after the artificial pneumothorax was induced, they diminished or disappeared after phrenic paralysis was added. As there were extensive adhesions in Slavin's cases, it is logical to assume that the diaphragmatic activity caused the enlargement of the cavities by tugging on the cavity walls. Gilbert (14) recognizes the rôle of bronchial stenosis. In one of his cases the progressive enlargement of the cavity finally led to its rupture into the pneumothorax cavity. He found the pressure higher than atmospheric in these cavities. Gulbring (15) described three cases in which the cavities enlarged under pneumothorax treatment, due to bronchial

stenosis. In one of the cavities the pressure was so high that perforation occurred. Gesztz (16) and Trojan (17) also recognize that kinking of the drainage bronchus leads to cavity enlargement and symptoms of sepsis after induction of pneumothorax. There is fever, pain in the chest, and increased cough, due to retained secretions. On physical examination, there is stridulous breathing or signs of catarrhal bronchitis with sibilant râles. The roentgenogram shows, in addition to the eccentric enlargement of the cavity, the undrained sputum with the familiar fluid level.

We have found that in some of these cases the size of the cavity varies in the different body positions. In the erect position, the bronchus may be strained by the weight of the lung or by the weight of the heart or of the abdominal viscera, acting through basal adhesions; this strain may be relieved in the horizontal position and the valve action may be suspended. The cavity thus decreases in size in the horizontal position (Fig 2).

The Rôle of Gravity in the So-called Selective Collapse—In pneumothorax re-fills, the air is generally admitted through the uppermost point on the chest with the

patient lying on the untreated side. This site of operation is selected particularly if selective collapse is aimed at, as the operator tacitly expects the air bubble in the chest to rise to the top, in this way, wounding of the lung by the needle is avoided. The injected air will remain at the site of entry as long as the patient remains quiet and motionless. Soon, however, the air and the movable underlying lung rearrange themselves in accordance with the laws of inertia and gravity, the heavier lung sinking toward the bottom of the chest, and the air rising to the top. As the roentgenographic examination is universally made with the patient in the erect position, the illusion is obtained that the air has accumulated above the diseased portion of the lung, which is generally in the upper lobe. Some practitioners are prone to the opinion that there is a providential selectivity on the part of the air bubble for diseased lung. One enthusiast (18) has expressed himself as follows: "So invariable is this property of the air to accumulate over the diseased tissue, that I conceive of pneumothorax being induced as a measure to determine whether lung disease is present and where." We do not know whether this diagnostic measure has been practised, but we expect that the resulting pneumothorax would always be apical in location, with the patient in the erect position. We find that in traumatic pneumothorax and in spontaneous pneumothorax, unassociated with manifest lung disease, gravity also governs the location of the air bubble. In these cases, when films are made in the erect posture, the pneumothorax is always of the "selective" type.

It is curious that the several American writers on the subject of selective collapse have uniformly ignored the factor of gravity. Some of them claim that, in tuberculosis of the lower lobe, the air will accumulate at the lung base, leaving the apex expanded, but we fear that these writers were guided more by good hopes than by careful observation. After an extensive review of the literature, I was

able to find but one illustration of a purported selective collapse in a basal lesion (19). Upon inspection of the roentgenogram, it becomes plain that there were extensive adhesions preventing the upper lobe from collapsing, high pressures were used so that the heart is pushed away and the diaphragm is flat. This was not a selective collapse but a forcible compression of the lung base.

CONCLUSIONS

1 Under normal conditions, the lung is but slightly stretched by its own weight, largely due to atmospheric pressure holding the lungs against the parietal pleura in opposition to gravity. The lung is also protected from excessive stretching by the heart and abdominal viscera. After the induction of pneumothorax, the lung sinks toward the bottom of the pleural cavity by its own weight. In case of mediastinal or diaphragmatic adhesions, the heart and abdominal viscera exert traction on these adhesions, sometimes tearing them.

2 The lung moves about freely in the pneumothorax cavity during changes of posture. In films taken in the erect position, the air bubble appears on the top of the lung, producing an illusion of selective collapse; in films made in the knee-chest position, the air readily shifts toward the diaphragmatic region in accordance with the laws of gravity and inertia.

3 The weight of the lung may kink one or more of the lobar bronchi, producing massive atelectasis. If the bronchial lumen is but partly occluded, there will result obstructive emphysema and enlargement of the cavities in the lung treated by pneumothorax.

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RETROGRADE PYELOGRAPHY¹

A DESCRIPTION OF THE ROUTINE PROCEDURE AT JEFFERSON MEDICAL COLLEGE HOSPITAL

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THE method of procedure of retrograde pyelography in Jefferson Hospital has not varied since 1912, when Professor Willis F. Manges first described the advantages of injecting the opaque solution into the renal pelvis under fluoroscopic

control. This is a preliminary to pyelography, and adds, we believe, distinctly to the comfort of the patient, as well as to the safety and accuracy of the entire procedure. This statement is just as applicable to-day as it was then. Excretion urography has not



Fig 1 Roentgenogram showing the catheter to be angulated in the ureter due to a break near the tip



Fig 2 Roentgenogram showing both ureters catheterized and in a very bad position. Pyeloscopy was not employed either before or during injection

control. Every retrograde pyelographic study at Jefferson Hospital since that date has been done under careful fluoroscopic control. The term "pyeloscopy" is used for the sake of brevity. Dr. Manges in his paper on this subject says "Pyeloscopy

supplanted retrograde pyelography as some would have us believe, but has made retrograde pyelography the more accurate procedure in roentgenologic diagnosis of renal pathology. The highest degree of efficiency of retrograde pyelography can be attained only by practising pyeloscopy.

Dr. Manges' reasons for asking to observe the injection fluoroscopically were

¹ Presented before the Radiological Society of North America, at the Twentieth Annual Meeting at Memphis Tenn. Dec 3-7 1934



Fig 3 Photograph showing technic of injection under fluoroscopic control on an ordinary Potter Bucky diaphragm table



Fig 4 Photograph showing technic of making film with the fluoroscopic tube



Fig 5 Small films made with fluoroscopic tube Fig 5 A (left) Kidney completely filled Fig 5 B (right) Kidney partially filled on a 14 X 17 Potter Bucky diaphragm film

that frequently they were unsuccessful in obtaining satisfactory pyelograms—patients were having a great deal of pain from over-distention—and that because of frequent re-examination the work of his department was unnecessarily increased. We may add that if excretion urography does not give us the required information, we look to retrograde pyelography as the final court of appeal. The advantage of

pyeloscopy in such cases remains undisputed.

There should always be a preliminary radiographic examination of the entire urinary tract. The films should be of such quality as to show the outline of the kidneys—their size and position—and any calculus or other density in the region of the kidneys, ureters, or bladder.

Previous to the day of the examination,

the patient is instructed to partake of a light supper, and later in the evening one ounce of castor oil. On the morning of the examination, a simple soap-suds enema is administered. No breakfast is served. The preliminary radiographic examination is then made.

There have been quite a few cystoscopic tables that are equipped with the Potter-Bucky diaphragm and x-ray tube for making pyelographic exposures. Recently, there has been constructed a cystoscopic table which permits fluoroscopic observation of the injection. We have such a table at Jefferson, and it is used frequently. We still adhere, however, to the x-ray table that combines the advantages of the fluoroscope and Potter-Bucky diaphragm, in any position from the Trendelenburg to the erect.

There is no real objection to removing the patient from the cystoscopic table to the fluoroscopic one with the catheters in the ureters after the cystoscope has been removed. The catheter rarely causes pain unless it is inserted too far, in which case it may curl in the renal pelvis or enter a calyx and cause distinct discomfort. In a few instances the catheter will have a tendency to slip out of the ureter, such cases are rare. Seldom is it necessary to repeat cystoscopy because the pyelogram is unsuccessful, or to repeat cystoscopy because the catheter is in the bladder and not in the ureter, after the patient is moved to the fluoroscopic room. We know of only two such cases during the last five years. In one case the patient presented the interesting anomaly of double kidneys and double ureters on both sides, with an obstruction on each side at the lower end of one of the ureters. Catheters were passed into three ureteral orifices, two encountered no obstruction, and the third passed for a distance of 35 centimeters. The cystoscope was then removed, and the patient moved to the fluoroscopic room where we noted one of the catheters in the bladder. We were never successful in getting a retrograde pyelogram of this one kidney. The cystoscopic x-ray table



Fig 6 Photograph showing fluoroscopic examination of patient in an erect posture

was employed with no better results. Undoubtedly, excretion urography in this type of case is invaluable.

The second case was one of extensive tuberculous pyonephrosis, with bladder involvement. The cystoscopy caused the patient extreme discomfort. During the removal of the cystoscope, it was felt that the catheter had not remained in the ureter. In the fluoroscopic room our suspicions were corroborated by finding the catheter in the bladder. For this type of patient, Dr. Hugh H. Young has made an improvement in a cystoscope which requires very little fluid distention of the bladder, and thus reflex irritability caused by the fluid medium in the bladder is reduced to a minimum.

The catheters used for pyeloscopy should, of course, be opaque and of sufficient size to be conveniently passed into the ureters. It should not be necessary to caution the operator that the catheters should be of excellent quality. The de-

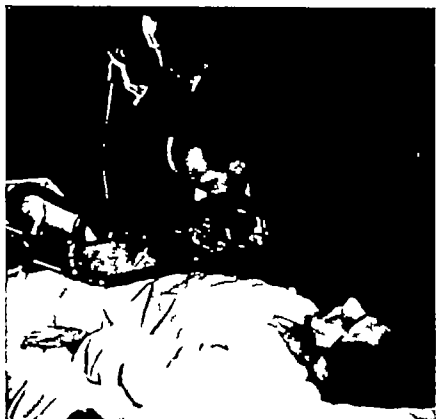


Fig 3 Photograph showing technic of injection under fluoroscopic control on an ordinary Potter Bucky diaphragm table



Fig 4 Photograph showing technic of making film with the fluoroscopic tube



Fig 5 Small films made with fluoroscopic tube Fig 5-A (left) Kidney completely filled Fig 5 B (right) Kidney partially filled on a 14 X 17 Potter Bucky diaphragm film

that frequently they were unsuccessful in obtaining satisfactory pyelograms—patients were having a great deal of pain from over-distention—and that because of frequent re-examination the work of his department was unnecessarily increased. We may add that if excretion urography does not give us the required information, we look to retrograde pyelography as the final court of appeal. The advantage of

pyeloscopy in such cases remains undisputed.

There should always be a preliminary radiographic examination of the entire urinary tract. The films should be of such quality as to show the outline of the kidneys—their size and position—and any calculus or other density in the region of the kidneys, ureters, or bladder.

Previous to the day of the examination,

ureter. The catheter was withdrawn until it straightened itself out before the injection was started.

The opaque solution, sodium iodide from 20 to 25 per cent, is used exclusively

It is felt that simultaneous bilateral pyelograms are not to be recommended, although many urologists have the roentgenologist make bilateral pyelograms. It would seem that if pyeloscopy is employed



Fig 10 Single catheter used to inject a case of bifid ureter, filling both kidney pelvises

at Jefferson. For cystographic purposes, the strength of the sodium iodide need not be over 5 per cent. Lipiodol has never been used in our clinic for retrograde pyelography. Mainly because of the expense involved, the substances used for excretion urography are rarely used for retrograde work.

In regard to the method of injecting the fluid into the renal pelvis with a syringe, or using the gravity method of allowing the solution to run into the renal pelvis, we find the latter procedure more satisfactory. It is the exception rather than the rule to use the syringe method.

as a preliminary to retrograde pyelographic work, little or no ill effects should be noted if both kidneys are injected at one sitting. However, we feel that it is safer to inject only one side at a time. We have not seen any complications following bilateral pyelograms when pyeloscopy was employed.

After the opaque catheter is introduced into the ureter, the patient is brought to the pyelographic room of the x-ray department, where he is routinely fluoroscoped to determine the location of the tip of the catheter. We feel that the most advantageous site for the catheter tip is at the level



Fig 7 Films made at the same stage of respiration with the patient in (left) erect and (right) prone positions. Kidney is shown to be movable.



Fig 8 Photograph showing fluoroscopy on a cystoscopic table.

Fig 9 Two opaque catheters in place, in a case of bilateral double ureters. Catheters are in a bad position.

fect most often observed is a break one-half inch from the catheter tip. Constant use of the elevator on the operating cystoscope, for purposes of guiding the catheter into the ureteral meatus, causes a scaling of the varnished surface of the catheter. Also, the eyes of the catheter are responsible for a certain amount of weakening

in this area. Repeated sterilization eventually produces a roughened, very flexible tip. The catheters should be thoroughly examined by the cystoscopist before each procedure.

A defective catheter (Fig 1), noted on fluoroscopy, was used in one instance with the result that it bent upon itself in the

tablished the desirability and necessity for pyeloscopy, we have followed this procedure routinely. We have not blindly injected a kidney at Jefferson in over twenty years. The advantages of precision and accuracy far outweigh the extra amount of time consumed in making a complete, satisfactory study.

SUMMARY

- 1 The routine procedure of retrograde

pyelography employed at Jefferson Medical College is described in detail.

- 2 The method of studying patients fluoroscopically on the cystoscopic x-ray table is mentioned.

- 3 Technic used in examining cases in which anomalous ureters are present is reported.

- 4 The necessity for pyeloscopy, in order to make a complete and accurate study, is emphasized.
-

of the iliac crest, or lower. If the catheter is at a higher level (Fig 2), or if the catheter is angulated (Fig 1), it is withdrawn and replaced in a satisfactory situation.

The burette is connected with the catheter, and the injection is done by elevating the burette and letting the sodium iodide solution flow in by gravity. The injection can be stopped at any point by pinching the rubber tube or by lowering the burette. Fluoroscopic control is exercised throughout the entire injection (Fig 3). By pyeloscopy, we watch the filling of the kidney and, thereby, prevent over-distention. Frequently, the kidney pelvis is so irritable and the filling so difficult that it is impossible to make a satisfactory Potter-Bucky diaphragm film. In these cases we make a quick exposure (Fig 4), using the fluoroscopic tube with the film on the anterior aspect of the abdomen. We use a small diaphragm opening to avoid scattered radiation.

Roentgenograms revealing the kidney well filled at the time of the fluoroscopic examination compared with the same kidney filmed on the Potter-Bucky diaphragm are shown in Figure 5. The latter film was made immediately after the former, but due to contraction the kidney is not so well filled at this time.

Under fluoroscopy, palpation of the abdomen in reference to the urinary tract becomes an exact science. Definite localization of points of tenderness or of fixation are established. We can determine whether tumor masses in the abdomen are a part of, or attached to, the kidney. By pyeloscopy, the effect of respiration on the position of the kidneys can be seen. The patient is fluoroscoped both in the upright (Fig 6) and in the prone postures (Fig 3), and films are made if indicated (Fig 7). The film made with the patient in the erect position shows the kidney to be below the level of the iliac crests. In the recumbent position, it is at a much higher level.

We always make a 14×17 Potter-Bucky diaphragm film with the patient in a recumbent position, and, recently, we have been making a similar film with the

patient lying on the side of the catheterized ureter.

Those patients whose ureters are difficult to catheterize, or in whom transportation is difficult or contra-indicated, are cystoscoped in the pyelographic room. Our cystoscopic table is equipped with a tube under it, so that we are able again to exercise fluoroscopic control for the injection (Fig 8). The procedure is essentially the same as in the examination of the patient who has been catheterized before coming to the x-ray room, except that we do not examine him in an upright position or make lateral films of the abdomen after injection.

Occasionally, we are faced with unusual conditions which require variations in our routine. The study of some ureteral anomalies needs special technique. When we are examining a case of double ureter (Fig 9), we catheterize both of them. In such a recent case, while doing the routine fluoroscopic examination before injection, it was noted that the catheters were at too high a level. They were both withdrawn before the sodium iodide was introduced.

The bifid ureter presents a different problem, the catheter must be withdrawn to a point just below the bifidity before the injection is started (Fig 10). Usually, a clue to the presence of a bifid ureter can be obtained by careful pyeloscopy at the time of injection. A small amount of the opaque solution can be seen entering both ureters at the point where the ureter separates into two parts. Then, by withdrawing the catheter to this level both parts of the ureter and both kidney pelves can be injected at one time.

After the injection has been completed and the necessary films made, the catheter is allowed to remain *in situ* if drainage of the kidney is difficult. In other instances, in which drainage is good and in which it has been seen that the solution regurgitates into the bladder alongside the catheter, the catheter is withdrawn. Fluoroscopy is frequently resorted to, in order to determine if the kidney empties properly.

Since 1912, when Dr. Manges first es-

apparatus which was built at the University of Minnesota and which has proved to be very useful during the last two years

tions supplied with half a gram or less of radium in solution

The two chief features embodied in the

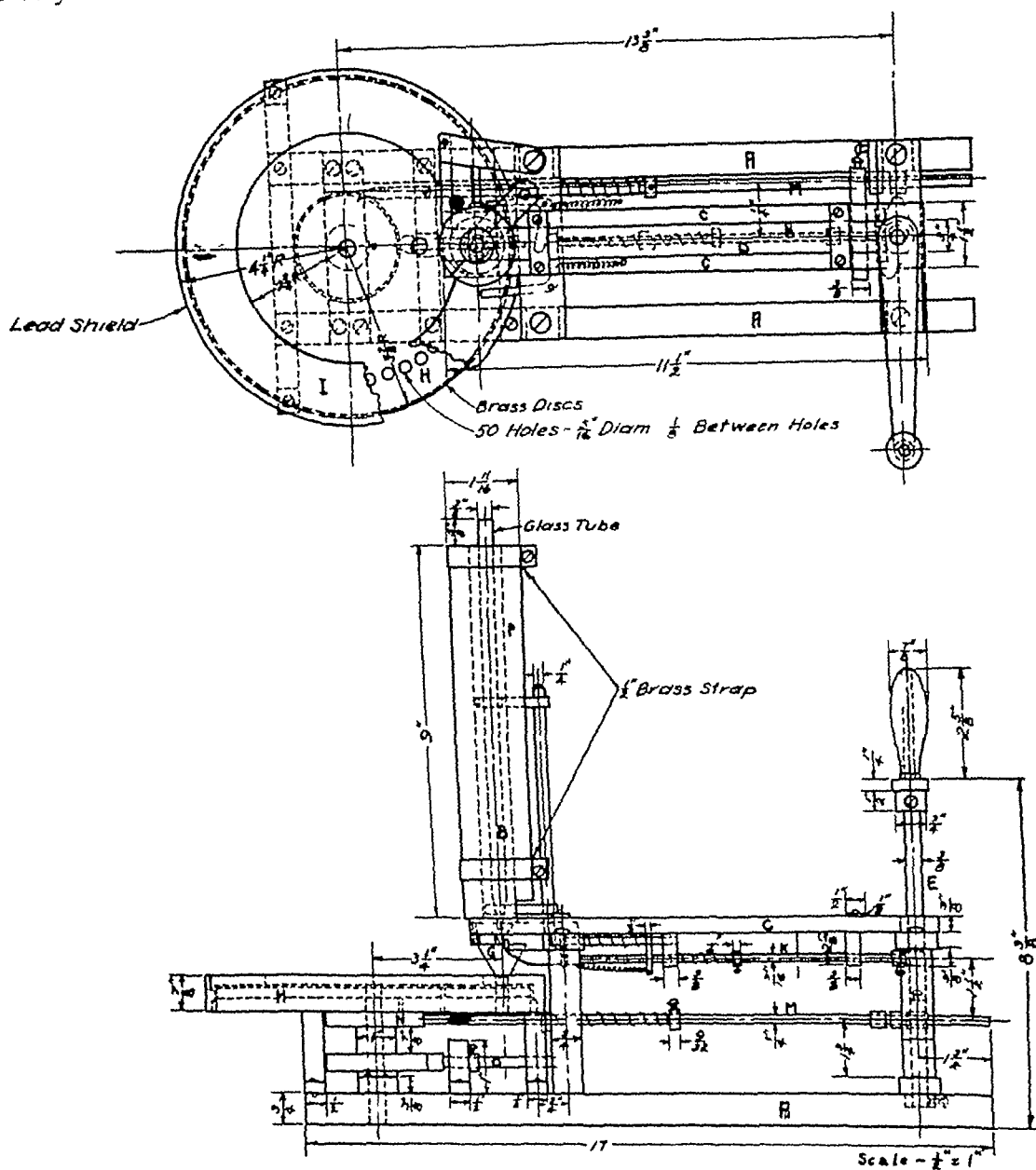


Fig 2—Side and top view of the implant-cutter (see Figure 1 for explanation)

The principle applied is self-evident and has previously been utilized by G. Failla at the Memorial Hospital, New York City, for construction of a larger and more elaborate implant-cutter. However, the one described here can be built at a rather small cost, which is important at institu-

semi-automatic implant-cutter are ease and speed of manipulation, and adequate protection to the person preparing the implants. The cutter delivers implants of any desired length between 2.5 and 6.0 mm, and deposits each one in a separate pocket of the container in order that the

A SEMI-AUTOMATIC IMPLANT-CUTTER

By WILHELM STENSTROM, PH D, and CARL E NURNBERGER, PH D, *Minneapolis*

Section of Biophysics and Cancer Institute, University of Minnesota

TECHNICIANS who collect and handle radium emanation are inevitably exposed to some radiation. The accumulation of the effect from such exposures may easily exceed the safe limit, with serious consequences. It is necessary, therefore, to take certain precau-

maximum, and it is evident, therefore, that a person handling this tubing for more than a few minutes would be exposed to a fair amount of radiation. The whole tubing can be cut off from the emanation plant immediately after it has been filled. It then has to be cut up into a number of im-

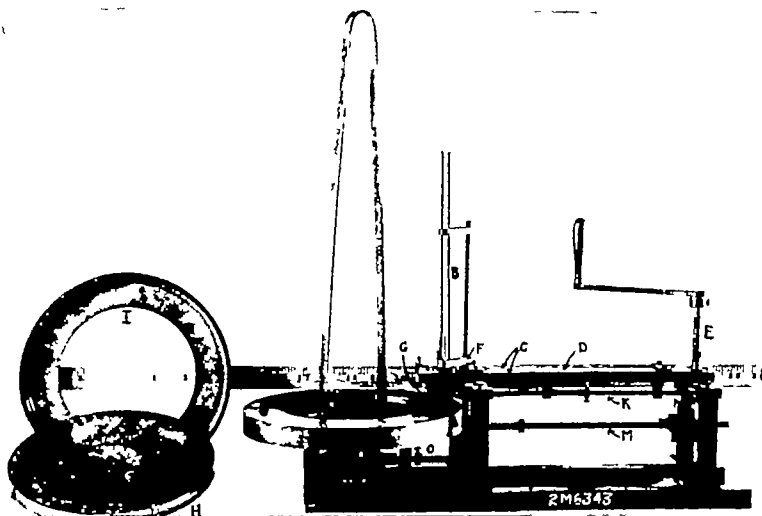


Fig 1—Machine used for semi automatic cutting of gold implants. *A*, steel base, *B* glass tube through which gold feeds into the cutter, *C* fixed bars which hold the stationary blade, *D* bar which holds the movable blade, *E* crank shaft with cams, *F* coil spring to release gold tube from the stationary blade, *G* funnel to guide implants to the container below, *H*, implant container, *I* lead protection screen, *J*, lead screen and implant container with long handle attached, *K* shaft to operate the wire brush and bronze spring stop below the blades, *L* part of the steel frame of the cutter, *M*, shaft to rotate the implant container, *O* break arrangement to regulate the rotation of the container through small angles

tions, and it is, of course, best to reduce the exposure as much as possible. An automatic implant-cutter is one of the most helpful devices to reduce the time required to handle implants and to minimize the exposure.

Immediately after a piece of gold tubing has been filled with radon on the emanation plant, it sends out only a negligible amount of gamma rays. This radiation increases rapidly with time, to reach its maximum value after about five hours. After one hour the value exceeds 50 per cent of the

plants, and this process, which requires an appreciable time, used to be performed manually by means of a pair of ordinary diagonal nippers. As long as only a few implants have to be made each week, it is safe enough to use this method, but when the number of implants required exceeds 100 per week the danger of too much exposure during such manipulation becomes appreciable. It then becomes advisable to eliminate this exposure by the use of an automatic or semi-automatic implant-cutter. We shall here describe a rather simple

measuring equipment and will be described in detail elsewhere

The lead shield, *I*, covers the pockets and the outside edge of the container. The shield rests on top of the plates when they are being carried about, but when the container is on the cutter to receive implants, the lead is held stationary by three short posts which support the lead slightly above the plates. There is a small hole in the lead directly below the funnel and over a pocket of the container.

The rotation of the shaft, *E*, operates all of the movable parts of the cutter by means of three cams. The function of the top cam has already been described; the second cam moves a small rod, *K*, parallel to the base of the instrument. This motion of the rod in conjunction with a lever arrangement under the bar, *L*, causes the piano wire brush to move sidewise directly beneath the blades. It also withdraws the "stop" from under the blades when the implants are swept away. This prevents free implants from lodging on top of the "stop." The bottom cam operates the shaft, *M*. A trigger on the end of *M* catches in the teeth of the sprocket wheel (*N*, Fig 2) just below the implant container. The forward displacement of *M* rotates the container through a small angle, just sufficient to bring the next empty pocket under the funnel. Below the sprocket wheel, but on the same axis, is a disc with fifty notches cut in its circumference. A wedge-shaped pin, *O*, fits into these notches and is held there by a spring. The disc with the pin serves as a break to prevent the implant container from rotating after the crank has stopped.

The top cam is soldered to the crank shaft, while the other two are held by set screws. The relative positions of the cams are important because each step in the act of cutting an implant must be properly timed. One revolution of the crank cuts one implant, deposits it in a pocket, and brings an empty pocket under the funnel for the next implant.

A considerable part of the protection to the technician, particularly from the

gamma rays of Radium C, results from the speed of cutting the gold tubes. The whole process of taking a gold tube from the radium emanation plant and cutting it into fifty implants is completed in less than two minutes. Not very much Radium C would be formed in this short life of the radon, and, therefore, the gamma-ray activity would be small. The distance between the technician and the active tubes contributes to the protection. The nearest part of the body to the active tubes is the hand—this minimum distance is about ten inches. Finally, lead shields are used where needed. The lead screen around the implant container has already been described. Another lead screen, *P*, in the form of a tube surrounding the glass, is shown in Figure 2, but was removed from the cutter when the photograph (Fig 1) was taken.

The machine is sturdy but not bulky in construction. All of its parts, particularly the tool steel blades, should withstand unlimited usage. No special amount of skill is required to operate it successfully, since merely turning a crank takes care of every step in the process of cutting implants. The handling of gold tubing and implants with forceps is almost entirely eliminated so that loss by accidental dropping does not occur.

The technic of radon therapy with gold implants has developed in recent years to the extent that it is often desirable to have implants of various strengths available for implantation. Our implant-cutter meets this demand, since the strength of each individual implant can be determined by its length. We generally cut our implants into two or three lengths. Typical groups were measured as follows: sixty-one implants of two lengths—of the shorter implants, seven contained 1.4 mc each, twenty-one contained 1.5 mc each, three contained 1.6 mc each; of the longer implants, seventeen contained 1.9 mc each, and three contained 2.0 mc each. Seventy-five implants of three lengths had the following strength: forty-three, 1.5 mc each, seventeen, 1.6 mc each, five,

radon content may easily be measured individually

The cutter is shown in Figure 1, and details of its construction are given in the mechanical drawing in Figure 2. A horizontal stand, *A* (Figs 1 and 2), made from steel bars, constitutes the base. About four inches above the base and near the center of the cutter are the blades. They are directly below the vertical glass tube, *B*. One blade is held across the ends of two horizontal bars, *C*, which are a part of the frame. This blade is stationary. The other blade is attached to one end of a third bar, *D*, which is made to slide freely between the other two. Each blade is solidly attached to its support by screws, which may be seen in Figure 1, directly below the bottom support of the glass tube. The other end of the middle bar is held firmly against a cam on the vertical shaft, *E*. The blades are opened and closed when the cam is rotated by means of the handle at the top of the shaft.

The blades are made of hardened tool steel, their top sides only are beveled. The edges are curved slightly so that contact is made at a point near their centers where the gold is cut. The condition of the edges is important: if they are sharp the gold tube is not pressed together and the radon leaks away. On the other hand, if they are too blunt, then wedge-shaped ends on the implants are produced. Properly conditioned edges may be found by the "trial and error" method. Demountable blades are preferable to permanent ones because used blades can be replaced or removed for repair without difficulty.

The gold tube taken from the radium emanation plant feeds into the cutter by its own weight through the glass tube, *B*. When the blades are separated, the gold tube falls between them to a "stop" situated a short distance below, consisting of a small flat piece of bronze which can be set at various distances from the blades, to be determined by the length of the implants. The bottom one-half inch of the glass is made of capillary tubing in order to prevent the short piece of gold tube, which is left

when nearly all of the implants have been cut, from slipping sideways in the glass and falling beyond the "stop." The inside diameter of the capillary is just large enough to permit a straight gold tube to fall through freely. In this manner all of the gold is cut by the cutter into lengths suitable for use.

The implants being made of 24 karat gold are, therefore, quite soft, and consequently, they and the uncut tube stick to the blades. The latter always sticks to the stationary blade and will not drop to the "stop" if allowed to remain so when the blades separate, therefore, a spring, *F*, has been added which moves the bottom end of the glass to a position midway between the open blades, thus releasing the uncut tube. The implants when stuck to either blade are swept away before the blades open by the sidewise thrust of a piano wire brush. The funnel, *G*, directly below the blades, guides the implants to pockets in a container below. The funnel can be turned to one side to permit the removal of the container from the cutter.

The implant container, *H*, and a one-quarter inch lead protection screen, *I*, are shown in Figure 1 (removed from the cutter). At *J* they are in place and the container is ready to be filled. A 14-inch handle is also attached. The container is made of brass and is cylindrical in shape. It consists of two parallel plates, each about one-quarter inch thick. In the top plate are fifty holes, located on the circumference of a circle near the edge of the plate. The bottom plate has one hole similarly located. The plates are held together coaxially, with their flat surfaces in contact, so that the two together form a container with 49 one-quarter inch pockets. The plates are rotated together about a vertical axis through their centers when being filled with implants; they can, however, be rotated separately. When the top plate turns with respect to the bottom one, the implants are one by one brought over the single hole in the bottom plate and dropped through. The separate rotation of the plates is used with the implant

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1.8 mc each, three, 1.9 mc each, four, 2.7 mc each, and three, 2.6 mc each. All of these implants in each group were cut from one end of the gold tube. The measurements show, however, that this is not a serious weakness in the method, for the various groups of gold implants of equal lengths are fairly uniform in their radon content.

To insure perfect sealing of all implants, we have found that occasional readjust-

ment of the blades is necessary. This is most probably due to wearing away of the surface of the brass cam near the top of the crank shaft. The blades, therefore, are not closed tightly. Replacement of the brass cam by one made of hardened steel will undoubtedly eliminate adjustment of the blades.

This apparatus has been used two years and has, during this time, been very satisfactory and helpful.

SOME REMARKS REGARDING THE MEDICAL EXPERT WITNESS AND THE PERSONAL INJURY SUIT SITUATION¹

By I S TROSTLER, M D , F A C R , F A C P , *Chicago*

RECENTLY, a friend asked me several questions regarding medico-legal matters, and believing that my replies may be of some slight interest to others, I will give them to you, not as an authoritative treatise, but merely as an argument for the betterment of the conditions mentioned.

The questions asked me may be readily inferred from the trend of the answers. I quote some of these questions in part.

I do not "consider that medico-legal testimony, in the average to-day, tends to a fair adjustment of the issues at stake." I say this because, if a shrewd, unscrupulous attorney employs an equally unscrupulous corps of medical expert witnesses, to swear to what he wants them to, practically every case in court and every suit tried, can be swung his way.

From my own personal observation, I have found that it is decidedly unusual for any corporation or other supposedly wealthy defendant, to secure honest justice in cases in which personal injury is claimed or alleged by the plaintiff. I have repeatedly seen judgments for large sums of money awarded plaintiffs in suits against large corporations, for alleged injuries which never occurred to the extent claimed (and testified to by expert witnesses), or *never occurred at all*, and I am sure that every physician in any large city knows of similar occurrences.

"Some of the evils observed?" *"Pertaining to the Doctor's testifying"* The attorneys, particularly those who handle personal injury cases, very frequently employ a group of so-called expert witnesses, who make a business of appearing on the witness stand in this kind of litigation. Some of these are willing to, *and do*, qualify as experts in practically every medical specialty. It is a fact that in one instance of my own observation, a man appeared, qualified and

testified as an expert psychiatrist in one court, as a surgeon in another, as an expert in roentgen diagnosis in another, and as an expert in pediatrics in a fourth court, *all during one afternoon, and on the same floor in the Cook County Court House*. I do know it for the truth, but I was very creditably informed that this same man, a licensed physician, qualified and testified as an expert in pathology the next morning. Of course, this man—and far too many others—will testify exactly as whoever employs him desires, and as the lawyer in the case wants it done.

Another evil, which we as roentgenologists are subjected to and have to complain about, is the calling or subpoenaing of physicians as ordinary witnesses, and, after their appearance upon the witness stand, qualifying them as experts and requiring them to give expert testimony, even to the point of requiring answers to hypothetical questions. Roentgenologists subpoenaed to identify roentgenograms made by them or for them are frequently subjected to this vexatious imposition, and are paid only the statutory witness fee.²

"Pertaining to the attorney's handling of the cases?" Personally, I have very little to complain of in this regard, but I know of others who have plenty to complain about. When I am on the witness stand, if the attorneys know me or have had much experience in trying to ruffle or confuse me, they usually do not try that sort of thing a second time. But others, who have not had much previous experience with me as a witness, soon learn that their bulldozing and attempted browbeating do not get very far.

Medical expert witnesses are usually subjected to two diametrically opposing at-

¹ Presented before the Chicago Roentgen Society, April 11, 1935

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1.8 mc each, three, 1.9 mc each, four, 2.7 mc each, and three, 2.6 mc each. All of these implants in each group were cut from one end of the gold tube. The measurements show, however, that this is not a serious weakness in the method, for the various groups of gold implants of equal lengths are fairly uniform in their radon content.

To insure perfect sealing of all implants, we have found that occasional readjust-

ment of the blades is necessary. This is most probably due to wearing away of the surface of the brass cam near the top of the crank shaft. The blades, therefore, are not closed tightly. Replacement of the brass cam by one made of hardened steel will undoubtedly eliminate adjustment of the blades.

This apparatus has been used two years and has, during this time, been very satisfactory and helpful.

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tempts to distort their testimony First, the attorney for one side of the case endeavors to secure an over-statement or exaggeration of the medical opinion, in favor of his client, and immediately thereafter the opposing attorney uses every possible effort to minimize, discredit, and reduce the weight or force of the expert's testimony Instead of trying in every way to secure the exact truth from the testimony of an unbiased witness, they treat that testimony much as opposing football teams treat the football—kicking, throwing, and carrying it back and forth from one end of the field to the other, instead of trying by every possible means to induce it to reach the smooth putting green and, from that, to the cup (of truth), as do our golfing friends

Be that as it may, I must say that I can not blame attorneys very much for trying to confuse witnesses, because some of the witnesses I have heard testify, invite that sort of treatment by their manner and the wording of their replies to simple questions, or by their apparent fear to state that they do not know the correct reply to other questions, *when they do not know* These witnesses should remember that no one man, be he lawyer, chemist, or physician, can possibly know all there is to his profession

It has almost invariably been my experience that the less merit a case has, the more do the attorneys for that side try to befuddle the witnesses, particularly the expert witnesses for the defense I have repeatedly observed that when an attorney realizes he has a weak case, he will *as a rule*, with numerous exceptions, of course, resort to browbeating and bulldozing of witnesses Many attorneys will take cases with doubtful or little merit and try to build up, or cause doubt in the minds of the jury as to exactly what was the expert witness' meaning They make an effort to throw up a cloud of tautological dust out of which they manage by more or less devious and rambling ways to lead the unwary witness into expressing himself in slightly different language, and then deliberately misinterpret this reply in slightly different phraseology

to be a contradiction of the previous statements of the witness By this process the attorneys try to, and in not a few instances do, mislead the jurors who as a rule have an IQ of eight-year-old children, into believing that the witness has contradicted himself

Practically all personal injury cases are taken by attorneys on a contingency or percentage basis, and not a few medical expert witnesses are employed under similar payment understanding Consequently, both attorneys and witnesses of this ilk will stoop to any ruse, artifice, trick, strategy, contrivance, or wile to make it appear that the testimony against their cause is not true or has been contradicted, while at the same time, they introduce incorrect, untrue, prejudiced, and even perjured testimony, from and by professional witnesses, many of whom are so suave and glib-tongued, while testifying, that no amount of abuse or ragging can shake their equanimity

"Pertaining to the presiding judge's attitude and ruling?" In regard to this, I am glad to say that in by far the greater majority of instances observed by me, the attitude of the judges and their rulings were in accordance with sense and justice However, I have repeatedly observed (and of this there is no question in my mind) that they see and interpret medical facts and conditions through a lawyer's point of view only, as must naturally be expected I mean that they look at these things from the legal aspect only, and do not see them as we of the medical profession must and usually do—from the human behavior, humane, and sympathetic aspect of affairs as presented to us from our study and knowledge of the conditions as they really are and as we have found them to be We see many of these things with differently trained eyes, as though through lenses or different colored glasses, which filter out some of the artificial or extraneous things We cannot expect untrained eyes to see these things as we do Incidentally, one of the few rare exceptions to the foregoing rule was the late William Howard Taft, who, when he was a trial judge, many years ago

in Ohio allowed the human and humane side of his nature to come to the fore, and who was by all odds the best friend of the medical profession who ever sat upon any State or United States Supreme Court bench

As to "*Suggestions to Correct some of these evils?*" I believe that the selection of expert witnesses and the admission of expert testimony should be more in the hands of the courts. Presiding judges should choose the expert witnesses from a list approved by the local or state medical societies for such service. If such a method were followed, it will be readily seen that much less biased, corrupted, prejudiced and or perjured medical testimony would be introduced and given. honesty and justice would be furthered and everything would be better, except the few hangers-on who derive their living from their nefarious trade.

Along this line, and perhaps more pertaining to the "*Judge's attitude and rulings,*" it is my opinion that trial judges could and should exercise their authority more often than they do to exclude professional witnesses from testifying. They surely and certainly must know these professionals as well as any one can, and yet they allow them to appear repeatedly, and apparently close their eyes to the fact that these professional witnesses come into court daily testifying for the same crooked lawyers at so much an appearance. I believe that the judges should require a greater and higher degree of competence, before allowing this or that group of professional witnesses to qualify as experts.

Also, presiding judges, in their summing up of the testimony and in their instructions to the jury, could at proper times and should in many instances, call attention to the fact that the testimony given by these professional witnesses should be taken with a grain of salt. This has been done in quite a number of instances, over the exceptions and objections of attorneys, but the actions of trial judges so instructing juries have been upheld by courts of last resort nearly every time that such instruction

was made a part of the cause for appeal. I am sure that all of us agree with Lloyd Paul Stryker, an eminent New York attorney, when he says,³ "If judges when they have before them a paid incompetent posing as an expert, were when they charge the juries, to analyze his alleged qualifications as well as his mercenary motives in giving his so-called expert testimony, justice would be far more frequently done. The power and capacity of English judges in this field is not the least of the reasons for the high reputation of English courts."

A New York confrère who thinks much as the writer does, recently presented a paper before the Society of Medical Jurisprudence of that city, and in a recently published paper⁴ stated

"It seems to me that when two people go to law, justice is on the side of only one. Therefore, the expert witness runs at least an even chance of selling his services to the side of justice.

"An expert goes on the stand and is sworn to tell the truth, the whole truth, and nothing but the truth. However, I have repeatedly observed in court that attorneys in the very nature of their job under the present procedure, are no more interested in bringing out the truth as it helps their side, than they are in suppressing the truth as it is prejudicial to their side. It is possible, therefore, for the expert under present procedure to tell the truth and nothing but the truth, but in view of the opposing (or even his own) counsel to object, it is practically impossible to tell the whole truth.

"Therefore, when justice would demand judgment arrived at by calm deliberation on the part of experts who know what it is all about and who can weigh the pros and cons and finally come to a decision, the final opinion is left to twelve citizens who know nothing about medicine, and who could scarcely give a valid scientific opinion even if the only appeals made were to their reason. When on top of it all it is considered that lawyers on two sides have wooed the emotions of this jury with all the arts and wiles that are summed up under the term 'forensics,' when it is remembered that a wife with a nursing baby in court is worth more to a plaintiff than are two medical expert witnesses (which is my opinion based on my own observa-

³ Courts and Doctors. Lloyd Paul Stryker, Macmillan, 1932 page 146

⁴ Suggestions for Improving Medico legal Court Procedure Ramsay Spillman Am Jour Surg, October, 1934 26, 199-203

tions, and you are at liberty to disagree with it if you like), so far as I am concerned, medico-legal procedure in court to-day is often nothing but burlesque, and while burlesque seems to have a place in the great social scheme, I hold that medical science has no place in burlesque.

"I might mention in passing that lawyers have made much of the inability of doctors to agree. It is my observation that disagreement between doctors is more common in court than it is in the hospital. I have been a part of many x-ray conferences where doctors would come into the case with divergent opinions, but as added evidence of one kind or another was introduced and the case was discussed dispassionately and scientifically and the added evidence was weighed pro and con, as a rule there would develop some degree of unanimity of opinion, thus is as it should be, for as Dr. Courtney stated in 1915,⁵ these opinions are derived from a series of facts and observations. But the court procedure of to-day could not be more unfavorable to a scientific study of a case by experts if it had been devised with malice aforethought.

"The legal profession has tyrannized over the medical profession with no mercy at all, on the matter of subpoenas. As a would-be law-abiding citizen, I should have the constitutional right to pursue my legitimate pursuits where and when I please. If I make an appointment to see a patient in my office on Wednesday morning, and the patient is postponing other business to see me at that time, I should have the right to feel confident that, barring the ordinary hazards of life in a big city, I can see that patient. But any lawyer, be he ornament of the bar or just plain bar-fly, can send a process-server into my office on Tuesday just before I leave for home, perhaps after my secretary has gone, and if I open the door myself I may find a subpoena in my hand commanding me to lay all other business aside and appear at such-and-such a court at 10 A. M. Wednesday, unless I go, I risk a term in jail for contempt of court. The case is more likely than not to be some fracture case of which I saw the films at the hospital three years ago, and, pro-rating my monthly honorarium at the hospital for that case, my original stipend for my services to that patient may have been some such figure as eighteen cents. I am assured that if I am put on the stand as an expert I will be paid as an expert. How do I know in advance whether I will find myself appearing as an expert the following day for a respectable crowd, or for a gang with whom I would not be found dead at a dog fight? The general appearance of the process-server is more often than not a promise that the latter

will be the case. I deeply resent the indiscriminate and unintelligent use of the power of subpoena, I can assure the legal profession that a great many other doctors do also, and I advise the latter not to remain inarticulate on the subject if they do not like the present situation.

"The criticism of the legal profession by a distinguished physician nearly twenty centuries ago as recorded in Luke XI, 45 *et seq.*, finds a cordial echo of many a medical man of to-day. The situation of which the present paper is a complaint is, therefore, not a new development."

I am sure that all who hear or read the foregoing quotation will agree with the writer that the statements made by Dr. Spillman are well expressed and to the point at issue.

Provision should be made, either by statute or otherwise, for just and adequate payment for such testimony as requires expert knowledge, which we as physicians have a right to expect to be paid for, because that knowledge is our own private property, that which cost us much effort, time, and money to acquire, and which is our stock-in-trade and is, in fact, the only thing we have to sell. As physicians, we should have the same kind of legislation and legal protection that the laws of our States provide for the legal profession. If we were anywhere nearly as active in politics and law-making as are our friends of the legal profession, we would have the same kind of protection.

In regard to "*Steps in the way of co-operative understanding between the medical and legal professions*," as hereinbefore stated, we have little that would be really constructive or of value to suggest, except that the attorneys make a little more searching investigation of the merits of the cases before deciding to accept them. However, *honest, upstanding attorneys do that*, and honest, honorable physicians have little or nothing to fear from that sort of attorneys, and want nothing to do with others. We want no pacts or agreements with the blacklegs and shysters and need none with the honorable and honest attorneys.

One of my pet peeves along medico-legal lines in regard to court procedures, is the

⁵ Boston Med and Surg Jour, January 6, 1916

laxity of nearly all courts in relation to the identification of roentgenograms and the requirement of proper qualification of the witness who interprets them—if the roentgenograms are not turned over to the lay jury for interpretation, which is not so rarely done. I have dozens of times, when on the witness stand, been handed roentgenograms to interpret, which bore absolutely no identifying marks as to who or what they represented, when, where, or by whom they were made. This, an absolutely preposterous situation, occurred to me three times during the past year (1934), so it is not only an old story but is being done—or perhaps I better say *not*

being done—here and *now*. I went rather thoroughly into this subject in a paper in 1934.⁶

I am sure that you have been told nothing new in the foregoing, still I am vain enough to hope that some of you have been awakened to at least a better recognition of the situation, and perhaps even roused to a determination to try to improve our position, when we are called into court as witnesses.

25 East Washington St

⁶ The Legal Aspect of the Identification and Interpretation of Roentgenograms. I S Trostler. Am Jour Roentgenol and Rad Ther, November, 1934, 32, 5, 680-693. Reprints furnished at 12 cents each.

THE IRRITABLE COLON SYNDROME¹

By CLARK J. LAUS, M.D., *Syracuse, New York*

OUTLINE OF THE PAPER

- 1 Normal physiology of the gastro-intestinal tract (outlined)
- 2 Irritation
Neuromuscular apparatus,
Lowering of threshold (predisposing factors),
What can irritate, direct reflex
- 3 The response to irritation
Hyperperistalsis,
Mucus,
Reflexes
- 4 Symptoms produced and their mechanisms
Direct (pain, cramp, etc.), localization (referred pain),
Reflex, vasomotor, etc.,
Induced symptoms caused by the patient's therapy, etc.,
Type of stool produced
- 5 Diagnosis, interpretation of symptoms
(physical, laboratory, x-ray)
- 6 Test-outs for colon distress
- 7 Differential diagnosis
- 8 Treatment

OVER twenty years ago, B. W. Sippy introduced the term "irritable colon" as a descriptive clinical diagnosis. It was used particularly to avoid such inaccurate terms as "colitis," "intestinal indigestion," etc., in which hyperperistalsis of the colon was responsible for the clinical picture. It is to Sippy that I owe the background for much of what I have to say in the pages to follow.

What I have set down in this paper represents largely my own observations in Dr. Sippy's clinic, together with clinical experience in my own work over a period of nearly twenty years.

Colic has been known to physicians and laymen alike for centuries that hyperperistalsis of the colon is responsible for symptoms other than colic has not been so universally understood. It should be better appreciated that the colon is responsible for more abdominal complaints than any other organ in the body. Clinicians have observed that hyperperistalsis in the stomach and the small bowel very rarely causes pain or much discomfort, even in the presence of a certain degree of organic obstruction. It is well known, for instance, that annular carcinoma of the small bowel may cause so little discomfort that the patient does not present himself until high grade

obstruction is present and vomiting occurs. Many of these patients have noted that the wall of the abdomen at times had risen up in ridges for months previous. To explain these observations, several points in normal physiology may be brought out.

The gastro-intestinal tract under normal conditions carries on its motor activities as a unit phenomenon, each segment (esophagus, stomach, small bowel, and colon) contracting at its own rate under the stimulus of the intake of food.

The simplest way to sketch normal peristalsis is to trace a meal through the tract. The esophagus is merely a muscular chute propelling the bolus of food into the stomach in from one to four seconds, depending upon the type of food ingested. The stomach begins to contract as soon as material enters it, and actual emptying begins shortly thereafter. The rate and depth of gastric contractions vary within wide limits, as do the amounts of material that a given contraction may propel through the pylorus. However, under normal conditions, the stomach empties itself of an average meal in from three to four hours. As soon as any material enters the small bowel it is rather rapidly propelled onward. It should be remembered that the content of the small bowel is always liquid and that peristalsis is normally very active, thus, the small bowel empties itself of an average

¹ Accepted for publication March 28 1935

meal in from one to two hours after the last of the meal has left the stomach. It is in this relatively short time that the major portion of digestion and all food absorption takes place. The material entering the cecum is made up of water, excess secretions not absorbed by the small bowel, and finely divided undigestible residue of food. It is fluid or, at the most, mushy in consistency. In the colon, the time element in onward movement is radically different from that in the small bowel, the rate of movement in the colon averages only one-twenty-fifth of that in the small bowel. In other words, material entering the cecum takes from 24 to 80 hours to travel the length of the colon and pass out of the rectum. The wide range in time is due to the great variation in such factors as the make-up of the individual, diet, age, nervous influences, etc.

There are several types of contraction in the colon, those pushing the material onward (relatively weak peristalsis compared to the depth of the waves in the small bowel), undulating shuttle movements, haustral contractions, and the so-called peristaltic rush or mass movement. All of these movements are difficult to make out in clinical fluoroscopy except the peristaltic rush, which occasionally may be noted. Due to the fact that the material is still liquid in the cecum and transverse colon, and that it is being displaced by material entering the colon from the small bowel, the fecal stream is more rapid here than it is in the lower half of the colon. Material may normally reach the hepatic flexure six hours after the ingestion of the meal. As the absorption of water increases the consistency of the colon content, the rate of onward movement is definitely slowed. Thus material in the transverse bowel is mushy instead of watery, that in the splenic portion has a consistency of soft putty, and in the sigmoid the consistency is that of ordinary workable putty. Attention may be called to the difference in caliber of the right and left colon. As the residue is dehydrated it loses bulk and takes less space. From the lower sigmoid, small soft masses are pinched off and pushed along into the am-

pulla of the rectum. The ampulla, a physiological and not an anatomical "sack," may markedly vary its capacity by virtue of its great powers of distention. It holds an average of a pint of material with ordinary pressure, as observed in the barium enema. As the fecal mass in the ampulla and rectum increases in size, pressure against the walls increases. When a certain degree of pressure is reached, the physiological reflex—the "call to stool"—occurs. When the bowel moves, the ampulla and rectum are emptied to produce a soft formed stool about the size of a banana. The rest of the colon remains filled, this part of its content making up material which forms the stool of the next one or even two days.

The normal stimulus to contraction of the colon is a combination of the following three factors

- (1) Reflex—the gastro-colic reflex—As soon as peristalsis is set up in the stomach by the ingestion of food, the colon becomes active.

- (2) Pressure stimulation—The contact of the bowel content with the wall of the bowel stimulates contraction.

- (3) Chemical stimulation of the neuromuscular apparatus by the vegetable acids found largely in vegetables and fruits.

Just what and how much influence reflexes originating in the vegetative nervous system centers, the centers of the mid-brain, and those arising from emotion, have when colon function is normal, is difficult to evaluate. In the instances of pathologic peristalsis, the significance is marked and thus more apparent.

In the light of experimental observations in animals and man, direct and fluoroscopic, it can be readily understood that control of the multiplicity of known factors influencing peristalsis is virtually impossible. Description, classification, and the establishment of any rigid norm are likewise not feasible. Thus, finely drawn distinctions and arbitrary findings in given sets of experiments must be interpreted or applied in clinical instances with great caution.

It should be emphasized that evidence of hyperperistalsis in the stomach and small bowel is not common in the absence of obstruction. However, when hyperperistalsis can be demonstrated by the x-ray or observation of the abdomen, as in duodenal ulcer or pernicious anemia, the patient rarely complains of pain. I have seen patients with ulcer pain and peristaltic waves raising up the abdominal wall, in whom, after the pain was relieved by alkali, the waves rolled on as before. It is, then, only in the colon that demonstrable and significant perversions of peristalsis and contraction are responsible for symptoms in the absence of organic disease.

Why should this be true? It is due largely to the fact that peristalsis in the stomach and small bowel is *normally* active and fairly rapid, the contents are fluid, and there is no retardation of onward movement by haustral contractions. In the colon, on the other hand, peristalsis is *normally* slow and relatively feeble, the contents are less fluid over at least two-thirds of its length, and the mechanism of haustral retardation is present. Exception might be taken as to the slow rate of movement when the so-called peristaltic rush is considered—a mass movement of a fairly large amount of material over a long distance of the colon in one sudden rush. I have seen it only on the right side of the colon. It has been assumed to be a normal phenomenon, because it is observed so frequently. I have not heard any individual describe the sensation, nor have I seen it under the fluoroscope in any patient whom I considered to have a normal colon function.

Hyperperistalsis, cramp, or spasm is caused by exaggerated response of the neuromuscular apparatus of the colon, due to the following (1) hyperirritability to normal stimuli, (2) excessive stimulation (irritation) to a mechanism of normal irritability, (3) a combination of both the above. Usually a mixture of the two factors may be found. Worry, fatigue, and particularly emotional stress, lower the threshold of irritability, especially if these

conditions are operative over a long period of time. The lay term "nervous tension" perhaps describes this state of affairs best. When on this condition are superimposed dietetic errors in the way of too irritating residue, catharsis, high colonic enemas, etc., a vicious circle of no mean proportions is set up.

The most common factor in the predisposition to a hypersensitive neuromuscular apparatus in the colon is that of "constitution" or make-up. A large proportion of the patients suffering from symptoms referable to irritable colon belong to what I prefer to call the "vegetative nervous system unstable" group rather than the "allergic," etc. Along with colon disturbances, they have the predisposition to, or evidences of, such etiologically related conditions as migraine, urticaria, Quincke's edema, eczema, hay fever, asthma, hyperthyroidism, Raynaud's disease, etc., along with the myriads of vasomotor disturbances so commonly seen. In these patients, irritable colon is merely one manifestation of a hereditary make-up which is prone to perversions of vegetative nervous system physiology such as may occur in any system or organ in the body. Together with instability in the autonomic mechanism, manifestations of emotional instability are found. Exaggeration of response to emotional stimuli parallels that of the vegetative system itself. It is important to observe that the disorders of the nervous system noted above are matters of degree of response in terms of the normal, and in no way vary in the kind of response. Thus, patients of this group as a rule do not fall into the classification of true psychosis as it is to-day interpreted. It is easy to understand that emotional instability may act as a force lowering the threshold of irritability of the vegetative nervous system and, also, should some emotional conflict of sufficient import to the patient occur, as the direct "tripping off" mechanism as well.

Another factor in lowering threshold and increasing irritability lies in the increase in speed, strain, and artificiality of modern life.

Since there are all degrees of the make-up mentioned above, it would seem fair to postulate that many patients ill to-day would have adjusted themselves, automatically as well as consciously, in an environment with less strain. However, with the driving energy, loss of sleep, and emotional conflicts, so characteristic of life to-day, bombarding the human nervous system as they do, it is not strange that derangements in the operation of that mechanism occur. The material side of life can and does change with remarkable speed—human physiology only over the thousands of years. Thus is the capacity of the human organism to adjust itself to its environment and to other like organisms, so far outstripped in speed by that environment, that an increase in all disorders due to disturbed physiology may well be expected.

Any stimulus which can normally set up a response of the neuromuscular apparatus of the colon, directly or reflexly, may, when the threshold of irritability is sufficiently lowered, become an irritant. Thus, what causes trouble on one occasion, may not do so on the next. The etiologic possibilities in cases of irritable colon thus become legion. However, it is possible to group and somewhat classify most of the common sources of irritation.

I Irritants acting directly upon the gastrointestinal motor mechanism

(A) Diet—

- (1) Residue too coarse,
- (2) Vegetable acids too irritating,
- (3) Excessive quantity of residue or chemically stimulating substances which in normal quantity are not irritating,
- (4) Idiosyncrasies or allergic reactions to specific foods

(B) Cathartics—

- (1) Drugs,
- (2) Artificial roughage intake (bran, agar, psylla seeds, etc.),
- (3) Non absorbable oils (mineral oils, etc.)

(C) Enemas—

- (1) Medicated,
- (2) Large enemas, so-called colonic irrigations

(D) Bacterial exo-toxins

(E) Drugs and poisons (lead, arsenic, etc.)

(F) Thermal effects (cold foods and drinks)

II Reflex irritants

(A) Emotional reflexes

(B) Thermal effects (intensive chilling of the body surface)

(C) Bacterial toxins acting through the central nervous system or blood

(D) Allergic reactions

(E) Organic disease of the rectum or abdominal viscera

(F) Coffee, tea, and alcohol

I believe that fairly well balanced meals are the rule in America. Misinformation and ignorance, largely from advertising, are responsible for dietetic notions and fads which so frequently unbalance the diet. The idea that the colon produces and absorbs toxins has its root in folklore, medical as well as lay. It is continually played up by quacks and the sales pressure for patented foods, in spite of the facts easily available in standard physiologic texts. Trick reducing diets, vitamin foods, foods to supply minerals, offered with "scientific" plausibility that convinces not only most laymen but many physicians as well, flood the country. It should be remembered that the colon is not a true excretory organ in the sense that the kidney is, at all. Its function is merely to conserve water, salts, and probably other digestive substances by absorption, and eject the non-digestible material taken into the gastro-intestinal tract. Ignorance of true colon function, and the ascribing to the colon functions which it can not perform, explain much dietetic meddling.

The notion that a bowel is "sluggish" and, therefore, lacking in propulsive force, as is mirrored in the term "atonic constipation," induces physicians and laymen to attack the bowel with increasing quantities of irritating residue in the form of coarse vegetables, fruit, fruit juices, and artificial roughage. As a matter of fact, there is much doubt that, except in cord lesions and certain cases of arteriosclerosis, such a condition exists. I know I have never seen it.

Cathartics are effective because of their irritating properties. It is simply a matter of degree of irritation—running the gamut from croton oil to agar and mineral oil. They have in common the disadvantage of abuse, habit-formation, disturbance of rhythmicity, and the production of symptoms due to hyperperistalsis. Fortunately, digestion and absorption take place normally with such speed that only in the case of the continual use of drastics is there direct interference with nutrition.

Many people get into the cathartic habit on one or both of two bases. The patient taking the average cathartic is likely to empty the entire colon. Thus, even though he eats normally there is often no movement for from one to three days following. Worry over this, and discomfort caused by the cathartic, but which he ascribes to the fact that the bowel has not moved, force him to seek relief from another dose. The relief which comes when there is a movement convinces him that his course was proper. Here again misinterpretation leads him further into error. It is the "breaking" of spasm, to which the passing of gas or stool was merely an incident, that gave relief. This relief is permanent only when the circumstances setting up the irritable colon in the first place subside, and medication is stopped, neither of which occurs as a rule. Thus the vicious circle rolls on, one cathartic after another "wears out," which means that spasm is increasing in severity and duration under the lash of irritation, and a more powerful irritant is necessary to overcome it and get "relief."

In many instances, patients who never used cathartics became addicted to them because of their use post-operatively and in convalescence. I believe this to be a more common occurrence than is realized. The same situation may arise in any protracted illness in which the diet is temporarily unbalanced for any reason, and resort is had to cathartics.

With temporary relief of abdominal distress by a cathartic, vegetative nervous system reflexes causing symptoms else-

where in the body, the vasomotor system particularly, often let up. Thus the symptoms so frequently termed "toxic"—headache, dizziness, pallor, lassitude, scotoma, etc.—are also "cured" by the forceful "breaking" of colon spasm, and the reflexes dependent upon it. These symptoms by virtue of their origin recur, and the necessity for "getting rid of toxins" becomes a steady job. This is the second factor in the train of events leading to the cathartic habit.

What has been said above applies with equal force to the misuse of enemas. Continued use of enemas with soda, soap, milk, and molasses, etc., and the colonic irrigation, are as harmful as cathartics. It makes no difference whether the irritant is ingested or run into the bowel, the result is the same. The quantities of mucus of which the irrigators are so proud are the result of the attempt of the colon wall to protect itself from irritation, in most cases caused by the enema itself. Mucus from any surface is the response of that surface to irritation of any kind.

I believe that bacteria and their end-products play a less important rôle in colon irritation than is usually thought. Organisms normally present, especially when colon physiology has been previously disturbed, may produce end-products in sufficient quantity to upset the bowel further. The gas-formers of the intestinal flora group, in the presence of carbohydrates and an acid medium, set up a so-called "fermentative colitis." A putrefactive process may produce similar irritating split products in protein in an alkaline medium. These substances cause symptoms by local irritation, as do cathartics. I know of no trustworthy evidence of absorption in sufficient quantity to produce an intoxication.

Little need be said concerning local irritation by drugs not used for their cathartic effect. Arsenic is an example of this group.

In susceptible patients, the effect of cold foods and drinks is an important factor in setting up *hyperperistalsis*. This effect is operative through the gastrocolic reflex.

Indirect or reflex over-stimulation of the colon is seen most commonly in those patients belonging to the vegetative nervous system unstable group. The most common of these are the reflexes set up by emotion. It is common knowledge that fear, for example, often causes spasm and diarrhea. In emotional maladjustments, particularly those with a sexual angle, a state of almost tonic hyperactivity may be present. Some instances of irritable colon are entirely the manifestations of psychiatric situations. More often, however, especially if the condition is of any standing, one or more of the other factors enters into the picture.

Thermal effects arising from chilling of the body surfaces may have an important bearing in the causation of spasm. Swimming in cold water, or the cooling influence of rapid evaporation when lying on the beach are common sources of this effect. Improper clothing in the cold seasons of the year make chilling a possibility in setting up cramp. Heat, of itself, as is well known, quiets hyperactivity as a rule.

Circulating toxic substances, bacterial or allergic, may, through the brain centers and probably also by acting directly on the peripheral ganglia, "sensitize" and irritate the neuromuscular apparatus. Absorption from focal infection seems, in some cases, to be a definite contributing factor. Colon symptoms, accompanying acute infections with fever, fall into this group. Many times, however, the diarrhea and cramps associated with the onset of acute infections are due to cathartics administered before the patient is seen. "Allergic" cases represent the reaction of the vegetative nervous system to a specific protein with localization, at least partially, of the response in the colon.

Reflexes from inflamed viscera—gall bladder, appendix, and tubes—may be responsible for motor disturbances in the colon. However, it is much more common to find that the irritable colon is due to the therapy for the original condition rather than brought on by the visceral disease. This is especially true in long-

standing disease. Rectal conditions—fistula, fissure, infected hemorrhoids, crypt infection, and ulcer—are frequently overlooked as causes of abdominal symptoms on the basis of colon spasm. Unless the inflammation is acute, there may be little or no complaint of local pain. In many instances, the discomfort or pain in the abdomen is localized over the cecum. Rectal treatment has cured many of these cases after appendectomy had failed to afford relief.

The colon has the capacity to dilate, contract, and propel its contents forward by peristalsis. Its lining is absorptive, and secretes mucus which is a lubricant in the left half of the bowel. (A thin film of mucus may be detected on the surface of normal stools.) When irritated, an organ can react only within the scope of its physiology. The response of the colon in irritation, therefore, is an exaggeration in varying degree of its motor mechanism. Thus under irritation we might expect the following:

- (1) Violent peristalsis, and premature emptying of the bowel (diarrhea)

- (2) Spasm of the haustral contractions. These may be deep enough to prevent emptying of the bowel long enough for a normal quantity of water to be absorbed. The stool under these conditions is spastic—small hard balls, or ribbon-like and chunky.

- (3) Excessive secretion of mucus—a protective mechanism.

In practice, one often sees patients in whom all three phenomena are present.

It is significant that in many diarrheas, with the patient definitely aware of the over-activity of his bowel, there is no complaint of distress or pain. This observation links with that of the lack of pain in the presence of obvious hyperperistalsis in the stomach and small bowel. It would seem reasonable that if peristaltic over-activity does not set up pain in the upper tract, it would not in the lower. However, with the normally low grade peristalsis in the colon, the *degree* of hyper-contraction might make it possible for

sufficient cramping of the peristaltic mechanism to cause pain. Then, there is no mechanism comparable to the haustral contractions in the upper tract. Fluoroscopic observations and palpation during pain first led me to suspect that most colon symptoms, from colic to mild discomfort, are due to tonic spasm of this mechanism. I have observed the marked deepening of haustral markings seen in patients who happened to be having pain at the moment of fluoroscopy. On the other hand, I can not recall noting any contraction under the same conditions that I thought might be peristaltic in type. I am aware of the difficulty of interpreting what can be seen fluoroscopically, yet in thin subjects, with marked motor disturbance at the time of observation, I feel that fairly reasonable observation can be made and interpreted.

The element of pressure, and the influence of distention and stretching, are difficult to evaluate as factors in the production of pain, because they are so frequently associated with spasm. Then too, many instances of rather marked distention and stretching of a viscus occur in which, in the absence of evidences of contractions at the same time, pain is not complained of, although the patient may be aware of distention. While it must be admitted that stretching and distention may be factors in the production of symptoms in an irritable colon, my observations force me to feel that such influence is not a great factor in causation in many cases.

Patients often complain of distention and bloating—flatulence—or of a markedly distended rectum, when examination proves them to be in error. The association of flatulence with spasm and discomfort, and the fact that the patient can more easily identify flatulence and fails to recognize the cramp element, leads him to blame the wrong thing for his discomfort. The fact that he often gets relief with the passing of gas, causes him to associate gas and pain in a causal relationship. However, before gas can escape,

spasm must let up, which is the real reason for the disappearance of the discomfort. The next time the patient is in distress, even though flatulence be not present, he blames "gas" for the distress because he recognizes the same sensation that was present when he did have distention and got relief when flatus was expelled. The association of aërophagia with an irritable colon serves to further compound the error.

What symptoms are produced by these disturbances? It might be well here to note that the complaints in this condition may be so mild as to be merely slightly annoying, or they may be so severe as to simulate the story of acute intestinal obstruction, acute appendicitis, or gall-bladder disease. The patient usually states his complaint in the form of meaningless terms supposed to be diagnostically helpful, such as "stomach trouble," "gas," "gastritis," "dyspepsia," "acid stomach," "biliousness," "nervous indigestion," etc. "Heaviness in the ovary" or "pain in the heart" are terms used because of localization of pain in the region in which the patient thinks the organs lie. A more objective description of what is actually felt is confused by the patient's inability to describe or interpret what happens. The very vagueness, variability, and moving about of the symptoms are suggestive of a colon disturbance. This is understandable in the light of the lack of specific sensory mechanism, the inaccuracy of localization, and the phenomenon of referred pain. The common association of vasomotor symptoms with irritable colon disturbances adds to the confusion. Thus the patient is forced to translate the abdominal sensation into an idea which can be expressed in terms common to him and the physician. I know of no condition in which the same story varies so much in the telling, depending upon the social state, experience, mentality, and emotional state of the patient. His threshold to pain and the wide range in severity add to the kaleidoscopic picture of the condition.

Some of the common terms used by pa-

tients are listed below These symptoms may be classified according to their mechanism of production into four groups

(1) Symptoms due directly to the spasm element

Heaviness, weight, and pressure across the upper abdomen,

Tightness, fullness,

Rumbling and gurgling—gas moving about in the abdomen,

Ache, colic or cramp, pain (severe) coming in waves, "knotting" in type,

Tenesmus, constant desire for a movement,

Sensation of heat or burning across the abdomen

The symptoms and their behavior vary a great deal, as might be expected in view of the multiplicity of possibilities and circumstance, yet there are certain earmarks that may be brought out

Time and Circumstances of Onset—The patient often states that the distress may come on at any time, that it is spasmodic, and that it moves about in the abdomen The relation to food-taking is not constant Food may have little to do with the tripping mechanism, especially in cases with a neurogenic etiology There are, however, two types of relationship to eating that are common First, distress coming on immediately after eating, an example of the gastro-colic reflex mechanism It is *à propos* here to call attention to the fact that, in the absence of organic disease of the stomach or its coverings, or the ingestion of a frank local poison, the stomach itself does not cause discomfort or pain on the ingestion of food The second type of onset corresponds to the time at which the head of the meal reaches the cecum In this instance, cramp is instituted by the direct irritation of the wall of the bowel

It is when distress comes on at this time with some regularity, especially if the cramp is manifest as a burning sensation and is associated with regurgitation and "acid stomach," that confusion with the ulcer picture occurs This type of burn-

ing differs from that in ulcer in several particulars It comes on at times immediately after eating and is not constant when present, but comes and goes It is diffuse or felt across the abdomen, moving about and relieved only temporarily by alkali, and then, usually only if the patient belches, it goes over into cramp at times, and is often relieved by flatus or a bowel movement

Frequently the hand indicates the entire abdomen as the site of the pain Often the patient indicates with fair definiteness the course of the bowel, stating that when the pain shifts, it goes from right to left and not in the reverse direction Distress onset or subsidence is associated with rumbling and gurgling Usually, if there is any increase in severity, the heaviness, burning, etc., may change to a pain that is colicky, the patient recognizing the association if not the unity of causation of the two sensations As a rule, the patient sticks to one subjective description at a given level of hyperperistalsis No matter what the sensation at lower levels, when severe spasm is present, it is usually described as colic, cramps, or the vulgar but expressive term, "bellyache" The sensation presented at lower levels of hyperperistalsis may remain for minutes or hours some patients will say that it is always present It is usually associated with wave-like paroxysms of increased severity that are more easily recognizable as due to the colon

At any level there may be a sense of desire for stool In less severe instances, I think that this is tied up to past experience when relief was had from the passing of flatus or stool, a mental phenomenon (association of ideas) In more marked examples, rectal tenesmus and sphincter spasm occur, producing the sensation of a full rectum, even though the entire lower bowel be empty Obviously, rectal pathology enhances the likelihood of this mechanism becoming active

Pain over localized areas of the colon, if definitely and constantly localized over a small area, should raise the suspicion of an organic etiology, yet there are many in-

stances in which no such lesion can be demonstrated, either at operation or autopsy. Note may be made of some of the fairly characteristic sites for localization of pain.

Left Lower Quadrant—Here, spasm is perhaps the most common of all. It is usually seen in cases due to the abuse of cathartics. Also, it is here that the pain is most easily recognizable as colonic in origin because of the ease with which the sigmoid may be felt in spasm and the tenderness on palpation. The patient usually leaves no doubt of the site of his pain when the bowel is rolled by the hand.

Right Lower Quadrant—Pain here is almost as common, and because of the presence of the appendix, if still present, is more important from the standpoint of diagnosis. Pain at this point is most likely to occur under three conditions:

- (1) Severe and prolonged left-sided spasm, usually with "packing up" in the ampulla and rectum, the dyschesia or obstipation of the British writers,

- (2) The presence of rectal pathology,

- (3) Sigmoid irritation by inflamed adnexa, pressure, or invasion by endometriosis.

It is well known that in intestinal obstruction in the sigmoid, the pain is likely to be right-sided. The effort of the bowel musculature becomes greater the farther away from the lesion. In "spastic colitis," dyschesia, obstipation, and constipation, in which the mechanism of pain production is the same, i.e., irritation and spasm, simulation of low grade obstruction occurs. As a matter of fact, a low grade intermittent obstruction is actually present because of the "packing up" and the spasm holding for long periods. Hence, the "expulsive effort contraction" manifests itself on the right side.

The influence of tissue alteration incident to old inflammatory processes, appendicitis, influenzal perityphlitis, tuberculosis, tubal infections, etc., as a factor in right-sided localization is problematical. It certainly does not occur in all such cases. I have noted, however, that the cecum is

much more irritable, judged by its palpability and tenderness, and by x-ray observation, after right lower quadrant operations—usually, of course, appendectomy. This may be true whether marked pathology was found at operation, or not. It is difficult to judge whether the finding is due to residuals of the original pathology, the operation, or the fixation of the region in the mind of the patient.

While localization in the flexures occurs, it is not as commonly seen as it is in the lower quadrants of the abdomen. Theoretically, angulation and redundancy suggest themselves as causes. Actually, from observation of many cases with marked angulation and redundancy, such localization is rarely seen, which makes it difficult to accept this condition as a factor in any of them. Too, in many cases, with localization in the flexures, no particular "kinking" is seen.

Autopsy and surgical exploration of the abdomen in which many adhesions were found, have long since shown that unless definite interference with motility, sufficient to cause a definite degree of obstruction, occurs, there are no symptoms except in instances in which the bowel has been mismanaged. In many instances in which interference with motility could be demonstrated by x-ray or at operation, it has been possible to manage the bowel so that function was normal and the patient symptom-free. With these facts in mind, it is difficult to postulate configuration and non-obstructive adhesions as factors of pain.

Patients often describe the pain in the flexure region as an ache or a sensation of pulling rather than a cramp alone. This suggests traction on the hepatic or splenic ligaments of the colon due to over-activity of the bowel as the reason for localization. Radiation to the back in such cases also seems to bear out this possibility. Much of the distress in the left upper quadrant in irritable colon is caused by the pressure of gas in the fundus of the stomach.

Pain in the area of the transverse colon appears, and at times may be demonstrable by palpation and x-ray. However most of

the upper abdominal pain, in my experience, has been referred pain. I have no explanation of cramp localizing in this sector of the bowel.

Clinical application of the phenomenon of the conditioned reflex in localization in the colon is a fascinating subject for observation and speculation. In functional heart conditions this factor can be fairly well demonstrated to those who understand the mechanism. I have seen instances in which fear mechanisms were responsible not only for the reflex hyperperistalsis but for its localization as well. For instance, a relative dies of visceral carcinoma, the patient experiences pain, set up by any excitant, cathartic, or what not. There is accidental localization of pain in the area in which the relative's fatal growth was—apprehension and fear, and the vicious circle has been set up.

2 Referred pain or distress in an irritable colon frequently masks its origin. Unless the physician is aware of the possibilities and suspects the colon, that source of referred pain may easily be missed. Perhaps the most frequent type is that felt in the epigastrium, the "ball" or "lump" in the pit of the stomach of which so many patients complain. The cramp giving rise to this reference may be in any portion of the bowel. The distress may be felt only in the epigastrium as fullness, pressure, weight, heaviness, etc. It may radiate well up into the chest on either or both sides. Frequently, when the sense of bloating and pressure is marked, and especially if it is accentuated by distention of the stomach by aerophagia, distress in the precordium and palpitation occur.

When the colon is extremely irritable and sore, and there is reference to the epigastrium and chest, the patient's breathing is shallow, and false dyspnea is produced. In this instance, as in those of inflamed gall bladder, the downward thrust of the diaphragm increases distress. The shallow respiration is an unconscious effort on the part of the patient to protect himself from pain. Pain in the lower lateral areas of the back while not strictly referred in origin,

might again be mentioned here. Pain referred down the inside of the thigh is usually due to concomitant pelvic pathology rather than to bowel cramp, but occurs frequently enough to warrant comment. The same may be said of low sacral pain, which is a reference of rectal origin. A silent and therefore unsuspected rectal ulcer may be the cause.

The absence of the Head zone phenomena in this condition should be mentioned because of its differential diagnostic significance.

3 Associated vegetative nervous system symptoms, while they do not occur in all instances of irritable colon, do occur in the vegetative nervous system unstable group with such frequency and at times with such severity that any consideration of these patients would be inadequate without a discussion of this phase of the subject. These symptoms are important, too, because of the traditional misinterpretation of their origin and significance. "Auto-intoxication," "toxemia," and "toxic absorption" came into medical literature much more because of the insistence of patients that they felt "poisoned," or "toxic," than because of supportive facts from clinical and experimental laboratories. Headache and pallor have been confused with liver dysfunction and jaundice. Without going into controversies concerning research in toxic proteins and the production of symptoms by them, suffice it to say that to date no trustworthy evidence of the presence of toxins in the blood stream of these patients has been brought forward. Much of the supposedly supportive findings have come from the injection of toxic proteins into the blood stream of experimental animals in quantities not seen in man under any circumstances. Many tests for intoxication have been devised. Indican, for instance, can be found in most urines, and the quantity can be increased by feeding high protein, but there is no parallel alteration in symptomatology noted. On the other hand, clinical observation, supported by experimental work, abounds to show that these symptoms are reflex in origin. Two

common examples will illustrate this. The occurrence of headache with the rectum packed with feces and instantaneous relief on emptying the bowel. Relief comes too rapidly to be explained on the basis of toxin elimination from the blood. Also, the sudden cessation of headache under the impact of sharp emotion. Finally, there is the therapeutic test. If patients can be so managed that their physiology and psychology approach normal, the symptoms disappear without any material alteration in the possibilities for toxin formation and absorption. In clean-cut cases, this is very significant evidence. For instance, in an uncomplicated "bran" irritable colon in a vegetative nervous system unstable patient, in whom "toxic" symptoms are a prominent feature, these symptoms disappear with the distress as the colon again functions normally. Still more convincing perhaps is the instance of a clean-cut emotional conflict etiology. If the psychiatric problem can be eradicated, the entire picture clears up, with nothing else in the patient's diet or management altered by any other therapy. It is conceivable that functional derangements might cause chemical dysfunction and permit the accumulation of toxins as a result, but if true, it seems to me that such toxins should be found without much difficulty in some cases at least. Thus, until convincing evidence to the contrary is adduced, the weight of known facts forces the conclusion that the phenomena under discussion are reflex and not "toxic" in the generally accepted use of that term.

Vegetative nervous system symptoms arise from the same irritant acting on both the colon and some other area of the vegetative apparatus, or they become operative as a reflex from the colon irritation. Such disturbances, of course, may be entirely independent of colon irritation, as they are, for instance, in a ragweed hay fever in an individual with a cathartic-irritable colon.

Common symptoms in this group, which in my experience are more intimately related in etiology with colon disturbances,

will be discussed. Bizarre manifestations are occasionally seen.

Under the head of vasomotor reflexes we find giddiness, dizziness, headache, faintness, weakness, blurring of vision, scotoma, hemianopsia, paresthesia, and syncope. All of these may be transient, mild, or very severe. The headache is usually less focal than in migraine proper, and it is likely to be less severe and more transient. However, it may simulate or actually be migrainous, which is not strange because the mechanism is almost certainly the same for both—vaso-dilatation and vasospasm.

With giddiness there is often a sense of insecurity, inco-ordination, and transient periods of lack of concentrating ability or temporary asphasia. Weakness and a feeling of low blood pressure (which actually is a characteristic finding in uncomplicated vegetative nervous system instability) may be so marked that great fatigue is experienced on slight physical effort. Paresthesia, cold feet and hands, numbness, tingling, the "inner trembling" so characteristic in the hyperthyroid patient, are all common. With any of the manifestations noted above, pallor due to peripheral vasoconstriction (the usual basis of the sluggish liver idea) may be noted. Motting of the palms is noted. Cold sweats may be evidenced in severe cases. Syncope, often at the height of severe pain, occurs. Fainting while at stool is not rare. Palpitation and tachycardia are common reflexes, especially when the element of fear enters in. Spasm of the diaphragm and of the esophagus (globus hystericus) are seen.

One of the most common complaints is nausea, usually under some term such as "squeamishness," or a sense of over-satiation after a mouthful of food. Frank nausea is likewise common. It may be the only symptom. Under these circumstances, negative findings, suggesting any other cause of colon dysfunction and a positive finding, capped by the therapeutic test, reveal the origin.

The mental picture of the chronic dyspeptic of literature and experience is proverbial. No one is cheerful and smiling

with chronic abdominal discomfort, and this is particularly true of the patient with colon cramp. Some of the sourest and most harried faces I have ever looked into, belong to this class. With no other cause, the condition makes otherwise happy people irritable, sensitive, and low spirited. Actual depression of the single-day migraine equivalent type is common. It may be so severe that the patient fears for his mental state and is loath to admit the symptom. In instances in which there is an emotional factor, a most vicious circle is kept going. Often disentangling cause and effect is difficult, even after the patient has recovered.

Emotion, a function of the higher centers, must be considered a physiologic process. Hence, since vegetative nervous system control over the function, circulation, etc., of the cerebrum is admitted in principle, it is not strange that reflex disturbances in the higher centers could easily be responsible for emotional states seen in this type of patient. This could well be considered a purposeless, illogical functioning of a center reacting to a reflex with the only response of which it is capable. Thus, many patients term these emotional disturbances "phony" because no recognized, legitimate cause for them is at hand.

It is recognized that these so-called neurotic symptoms arise from many causes other than irritable colon. They are often enough seen independent of bowel disturbance. However, it is well to remember that they may serve as cause, effect, or both, in irritable colon. They are discussed here because unless relationships and mechanism are recognized, diagnosis and therapy alike are imperiled. It is a grievous error to diagnose and treat neurosis and neglect the diagnosis and management of the bowel condition, and *vice versa*. It certainly is indefensible to label the patient a neurotic, implying or stating that he imagines symptoms and could voluntarily control them if he would. Except in the major psychoses, I have seen no patient who imagined symptoms, although

there have been plenty of instances when the explanation of them was beyond me.

4. A fourth group of symptoms present in most cases includes disturbances induced by the patient himself in an effort to get relief from his discomfort. The longer the patient goes on, the greater and more varied the things he is told about and tries. Many of the "doses" do give some temporary relief, but cause more trouble later. The one most frequently noted is belching—it is well known that most patients attempt to "bring up" any type of abdominal pain. This is especially true when the sensation is one of fullness, pressure, and weight independent of its cause. The common relief in irritable colon by belching is due to changes in intra-abdominal tension caused by the sudden downward thrust of the diaphragm and the release of any gas that may be present. Spasm is thus broken and relief temporarily ensues. Practically all patients will insist that they do not swallow air. That they do can easily be demonstrated by physician and patient as well, under the fluoroscope. This may be fortified by the knowledge that unless an alkali be taken by an individual with free acidity, no gas is formed in the human stomach unless there is high grade obstruction with stagnation of food over at least a twelve-hour period, so that fermentation has time to become active. Thus, unless a patient has obstruction or takes an alkali, any gas in the stomach *must* be swallowed air.

The prevalence of "gas tablets" and "indigestion relief" medicines—most of which are soluble alkali—is mute proof of the extent of popular commitment in this question.

Pressure against the heart, or "pain in the heart," is due to cramp in the splenic flexure, with distention at times. The patient may have no idea that the colon comes as high as a broad hand's breadth below the left axilla in most persons, and he naturally refers to the pain as "heart pain." Anxiety may set up tachycardia or a shower of extra-systoles, and then he is certain that he has heart trouble. A second and perhaps more common cause is

distention of the fundus by air swallowing, with pressure upward against the diaphragm and consequent embarrassment to the heart. I have noted marked dislocation of the heart under these circumstances, with return to its normal position on belching the gas out. It is interesting to note that such dislocation may occur in some patients with no discomfort whatever, while in others a train of very disconcerting symptoms is set up.

"Hyperacidity" and burning are often due to the regurgitation of normal acid content into the esophagus. The esophageal wall normally does not have acid on its surfaces and is irritated by it. Frequently spasm is induced in the cardiac portion, and a mouthful of the material is forced into the mouth, which at the moment is the path of least resistance. The regurgitation is usually induced by an attempt to belch or by the semi-involuntary hiccough so frequently seen in "dyspepsia." Burning of this type may come on one or two hours after eating, and superficially simulate ulcer distress. The time of onset in this instance is dictated by the fact that uncombined acid is usually at its peak at this time and, also, the head of the residue column of the previous meal is beginning to distend the cecum. If this residue is irritating enough, distress ensues, belching for relief starts, and burning results. However, burning under these circumstances differs from that of ulcer in that it is present for only a short period, and disappears if the acid is washed down by saliva, water, or food, to recur as soon as material is ejected through the cardia again. Most significant of all, it always follows belching, hiccough, or any degree of diaphragm spasm under any other term.

The burning that is felt across the abdomen is more directly traceable to hyperperistalsis. It may come on immediately after meals, it is intermittent, likely to be diffuse, and moves around in the abdomen. It is influenced by alkali only if belching follows.

Rectal pathology—fissure, hemorrhoids, infected crypts, and ulcer—occurs as a re-

sult of loose stools induced by the repeated use of catharsis much more frequently than is generally appreciated. Because a hard stool causes pain and aggravates conditions after the pathology is present, many are led to the belief that the trouble is primarily due to that. Most patients very carefully keep the stools loose to avoid pain at stool, thus keeping up the process. A rectum regularly passing well-formed stools is rarely the seat of pathology. Pelvic pressure, pregnancy, and portal disease, of course, can cause hemorrhoids independent of rectal irritation. Likewise, rectal pathology often heals, if it is possible to keep the stools formed.

One of the most important details of the patient's history is the character of the stool. In only the occasional case due to mental reflex is the stool normal in caliber and consistency. Stools that are watery, mushy, ribbon-like, small, and chunky and in the form of small balls are all evidence of spasticity. Bran stools are often bulky, mushy, and gas-containing. Mineral oil stools are likely to be small in caliber and snake-like. Salines and more active drugs cause the stool to be mushy or frankly watery. The duration of symptoms, type of cathartic, frequency of its use and threshold are factors modifying the kind of stool produced.

The diagnosis of irritable colon is based primarily on an interpretation of symptoms as they mirror pathologic physiology. As is true in the diagnosis of any functional disorder, objective evidence, physical examination, laboratory and x-ray study are more valuable in excluding organic disease than in proving the functional.

Physical findings of diagnostic import are limited largely to palpation of the colon. Normally, this organ cannot be made out by the palpating hand. In irritation with sharp contraction of the musculature, the sigmoid may be rolled under the fingers—this is particularly true in the cathartic cases with loose stools. The bowel is tender, at times exquisitely so. The pain may be referred to the epigastrium. In cases in which hard stools are the rule, the cecum

may be the most easily palpable, and tender. Often in severe cases the entire colon can be mapped out as a tender, rope-like cord. Patients will usually recognize the tender colon as the source of pain. No other patient is so "abdomen-shy" as a typical severe irritable colon case. If spasm does not happen to be present at first, the bowel may be "rubbed up" and irritated into activity, usually to the manifest discomfort of the patient. Although some conscious muscle defense is shown, true rigidity is never present. Sphincter spasm, severe enough to suggest stricture, may be encountered. Proctoscopic examination shows nothing except a blush of the membrane and whatever incidental rectal pathology may be present.

The rest of the physical examination adds nothing directly save points of negative import. However, organic conditions of great importance as contributing factors in the etiology of the condition are often seen. Circulatory disease, and such constitutional conditions as tuberculosis, may be masked by complaints due to colon dysfunction. However, a complete physical examination should always be done.

Temperature, respiration, and pulse are normal. Studies of the blood, urine, etc., are negative. Stool examination of value is limited to observation of the consistency and form, outlined previously as indicative of spasm. Mucus as a reaction to irritation is often present. At times, great strings or casts of the bowel may be seen. There is no blood or pus in the uncomplicated case. In the fermentative type, the stool is mushy, bubbly, floats on water, and smells sour. *Clostridæ* may be seen microscopically. Set up in a Schmidt tube, the excess gas formation can readily be demonstrated. This type of stool is always acid in reaction. The putrefactive stool is alkaline, and has the characteristic odor of indol, phenol, and scatole. This latter type is not important clinically.

Bacteriology of the stool is so complicated that it is rarely accurately done, clinically. Except for the recognized organisms causing actual pathology, the bac-

teria present are of very little diagnostic significance. Overgrowth of the gas-formers in fermentive colitis may be demonstrated. The same is true of the putrefactive organisms in that condition.

X-ray Studies—What is done and how it is done are dictated by the clinical features of the case. In justice to the roentgenologist, all of the clinical data should be in his possession, that he may study the case and interpret the x-ray evidence clinically in the light of that knowledge. Thus, the roentgenologist becomes a clinical consultant in his specialty instead of a laboratory technician submitting "blind reports." The value of x-ray evidence would be greatly enhanced if this practice were even more generally followed.

X-ray evidence is most satisfactory when the barium enema is employed. As the enema is started, the rectum often balloons. Suddenly the column will streak up into the sigmoid, showing a narrowed lumen as far as the transverse colon. There may be a point where spasm can be visualized, with a tendency to balloon behind. Haustræ are seen, but the markings may be shallow. In the middle and right half of the bowel, haustral markings are more likely to be within the limits of normal. As the bowel is completely filled, certain areas, particularly on the left, may show spasm, forcing the material in either direction and leaving a section of the bowel with no barium showing. Study of the wall with the bowel full shows no constant defect, and, with time, all of the lumen can be seen to fill out. The contour, length, and configuration of the colon, in the absence of a defect or signs of organic obstruction, have no diagnostic significance. A long bowel with marked redundancy and so-called "kinks" will function normally, and show no symptoms in the absence of other factors causing motor disturbance. The position of the bowel in the abdomen is not of itself the cause of bowel dysfunction. "Ptosis" should be abandoned as a clinical diagnosis, if we are to assume that the ptosis is causing symptoms. It represents a build—the patient's habitus—not an acquired anatomic abnormality.

Significance can be placed on the actions of patients as the enema runs into the bowel. Many spontaneously exclaim that they cannot hold it, that it is producing the characteristic pain which brought them in. With expulsion, relief is experienced.

It is best to administer the enema without previous catharsis or enemas. At most, a plain water enema to clear the lower bowel should be used. Thus any possible spasm which might be set up by such procedures will not confuse.

The x-ray study is of especial value in ruling out organic pathology. Its value in a positive way is suggestive, not definitive.

Clinical "Earmarks" and Tests in Diagnosis—It is sometimes necessary, in order to clarify history, to place the patient on a fairly coarse diet and check on the distress in every way possible. Under these circumstances, the time relationship and the reaction of the patient to alkali, food, and enemas when he has distress can be verified. In obscure cases, with severe distress, the "test enema" may be employed. At the height of the pain, the patient is given a three-quart enema, one pint at a time, all the water to be retained if he can. As each pint is run in, he describes to the nurse his sensations. If he can retain it, he notes what happens on expulsion. The characteristic response is that a pint or two makes the distress so severe that he can hold no more. Relief comes with expulsion. It is necessary to know that the distress caused by the enema was the "old pain" made worse. If there is no influence whatever on the pain, the bowel is almost certainly not the source. If the distress caused was a "new pain," the same is true. A few patients get relief as spasm is broken by the entrance of the water—they are likely to have more severe pain after expulsion, as it takes hold again. In acute cases with grave possibilities in the diagnosis, such a test should be done by the physician himself and with circumspection. I have found the test of value both positively and negatively in almost all of the sources of abdominal pain.

Differential diagnosis at times is exceed-

ingly difficult because the manifestations are so protean. What Osler said of syphilis is equally true of irritable colon as far as abdominal symptomatology is concerned. The distress is not always distinctive—the frequency with which the condition is superimposed upon other syndromes, due to popular therapy—the frequency with which organic states not producing symptoms are found, and the fact that some portion of the colon is an intimate neighbor of practically all of the other symptom-producing viscera, all serve to complicate the clinical picture. Many of the associated symptoms are as frequently found playing the same rôle in other diseases, as, for instance, belching in ulcer, gall-bladder disease, heart disease, etc.

The most common conditions in which errors are likely are chronic appendicitis, acute appendicitis, gall-bladder disease, ulcer, heart disease, urinary tract disease, gastric crises, and neurologic lesions.

In appendicitis, the irritable colon is never accompanied by fever, leukocytosis, or the true rigidity. However, muscle defense, especially to pain caused by palpation, is common. Vomiting is not common unless headache is present. Colon symptoms run along day after day, any flare-ups being due to recognizable causes in most instances. The pain that moves about in the abdomen is often associated with rumbling, and the passing of gas with relief. The sigmoid is palpable and often just as sore as the cecal area. There is a definite history of bowel mismanagement and abnormal stools, and finally, on proper management, the pain disappears. It must be remembered, however, that since both appendicitis and irritable colon are common, they may occur in the same patient. However, there are many appendices removed without relief in these cases. Many times the acute appendicitis is merely an incident in the life of the patient, but not at all connected to the colon disturbance. There would be less confusion if the irritable colon syndrome were better recognized, and if the attack with fever, etc., in the history, or present complaint, however mild, were

more closely depended upon In patients with irritable colon, in whom acute appendicitis occurs, the difference in the two pains is recognized The patient often says "I never had this sort of pain before " It is not necessarily the severity of the pain that makes the difference, either

In the case of gall-bladder disease, what has been said about appendicitis holds true The gall bladder has long been given credit for the production of symptoms which it cannot produce Its symptomatology is not as vague as is generally taught Confusion due to symptoms referable to the bowel and other organs, is responsible for this Medication for the "liver"—salts, calomel, bile salts, etc—are all purgatives, and it is the rare instance of suspected gall-bladder disease that is not treated by one or the other of the laxative preparations Thus, except for the first attack or isolated attacks, a complication is nearly always present With the advent of better gall-bladder films in x-ray study and the use of the dye, more and more "silent" pathology in the way of non-filling and stones is being brought to light It must be remembered that gallstones are commonly found at autopsy in patients in whom no symptoms suggesting their presence were found in life There are far more silent stones than symptom-producing stones It may be permissible to remove obvious pathology in these cases, but it is not permissible to assume that the patient will be well if his symptoms were not due to that pathology Most of the unsatisfactory results in gall-bladder and duct surgery are on this basis If the suspected gall-bladder case has no evidence of bowel disturbance, the picture can usually be made out In those cases of long standing, with the bowel function corrected, gall-bladder symptoms, if present, will show up with sufficient clarity to warrant a correct diagnosis if the patient is under reasonably accurate observation

Due to the prevalence of laxative alkali (magnesia) treatment, self-medication, especially in most ulcers of any standing, the patients are prone to acquire colon disturbances Too, ulcer is common in the vege-

tative nervous system type of unstable individual who is also prone to bowel disturbance Usually, in spite of the admixture of symptoms, the ulcer condition can be proved At times, however, it is necessary to correct the bowel condition first, so that the picture of ulcer may stand out in relief in order that it may be recognized Most of the unsatisfactory results in ulcer management come from the aftermath of prolonged use of magnesia in alkalinization, and analysis of the symptoms will prove them to be colonic in origin Most intelligent patients recognize the difference in the distress very readily Many an ulcer patient has had a gastro-enterostomy done on the basis of the x-ray defect due to scar, when the symptoms were caused by the colon

Decompensated hearts and coronary hearts often present themselves with the complaint of "indigestion" Here again failure to recognize the origin of distress leads to the use of "gas tablets," etc, and the addition of discomfort through irritation of the gastro-intestinal tract Early decompensation, unrecognized for months, commonly gets into a welter of mixed-up symptomatology which must be untangled and the origins properly placed The practice of using salines to promote water-loss by bowel often causes more harm than good, due to the cramp and embarrassing distention produced

Disease of the ureter, in which urinary findings, bladder and ureteral symptoms, and the characteristic radiation are absent, may be covered up by bowel symptoms Cases in which nagging pain persists after bowel management are often due to stricture of the ureter Usually this pain is fairly well localized and, if carefully watched, will show enough urinary tract symptoms, radiation, desire to urinate, frequency, or relief from emptying the bladder, to warrant suspicion of the kidney and ureters so that appropriate diagnostic procedures are introduced and the lesion discovered

Disease of the colon itself—carcinoma, diverticulitis, and infections—must always

get back eventually to a fairly average normal diet. There are, however, so many individual reactions to foods, due to appetite, likes, and dislikes, that each case must be worked out as it progresses. Each patient must be taught the rules of the game as they apply to him. Some are permanently restricted in their intake of certain foods by the limitation of hyper-irritability of their colonic mechanism.

Drugs—Useful drugs are of two types, anti-spasmodics and sedatives. Belladonna and hyoscyamus preparations may be used. The dosage should be up to tolerance. In my experience, anti-spasmodics have not been uniform in their effect. Drugs to depress nervous irritability, preferably of the barbituric group, are likely to be of more value. Steady use over ten-day periods with an interval of a few days, is often advisable over a couple of months' period. This is especially true in the vegetative unstable group. Bromides are too prone to cause skin rashes if used in adequate dosage for very long. Powders containing salts of bismuth and calcium are valuable in some instances in slowing down peristalsis, in the effort to get a formed stool. Opium should be used only in acute cases of short duration in which there are severe pain and diarrhea, not controllable by other means.

Physiotherapy—Heat in any form is the most effective anti-spasmodic. It may be applied to the abdomen in the form of a pad or hot water bottle, especially after meals. It may be used each alternate half-hour throughout the day. In a few cases, heat seems to stir up peristalsis. Hot tub baths may be used if care be taken to avoid circulatory depression. Friction massage of the body, particularly in the elderly and debilitated, is of value as a sedative. It should not be done on the abdomen. Deep pressing of the abdomen is to be avoided. Supports, corsets, and belts of any kind have been advocated, especially in chronic cases. However, on the whole, it will be seen that the condition is unchanged. On many instances in

which the pressure forced the viscera lower than they lay normally. That these appliances often afford a measure of relief is granted, a relief from two sources: first, counter-pressure, just as the youngster with green apple colic gets relief from putting his elbows across his lower abdomen and doubling over; second, the soothing effect of the heat produced. Many patients are aware of the increase in discomfort when the abdomen is cold and of the relief from warmth, and wear heavy abdominal binders.

Changing the intestinal flora by the administration of acidophilus milk, etc., has been of only slight value, and then only in fermentative cases. On the other hand, I have seen many cases made worse by the laxative influence of the milk. Fermentative processes are best controlled by rigidly curtailing the carbohydrate intake and the use of alkaline powders. In putrefactive cases, the protein is cut down. Otherwise, in both types the management is the same as outlined above.

Psychiatry—Cases in which emotional conflict is a factor are common. Often the disturbance can hardly be termed psychiatric. Fear of disease, irritations and troubles which would be spontaneously adjusted in a less highly irritable person, should be patiently and without levity "ironed out" and explained. However, unless the physician has some sound understanding of emotional mechanisms, great care must be exercised. Superficial explanation, moralizing, or illogical use of suggestion may be worse than failure. In many instances, the difficulties do veer toward the more complicated psychopathologic and should be referred to those specialists more competent to deal with such problems. Often the general medical management may ameliorate the condition somewhat without treatment of the emotional angle, but as a rule not much permanent headway is made. Just what influence the mental problem has on the colon condition dictates what must be undertaken and what the result is likely to be.

be ruled out. The presence of blood and pus in the stool, fever, localized pain, etc., coming on "out of a clear sky" or in attacks, should immediately suggest laboratory and x-ray examinations, with endoscopy to clear up the diagnosis. This is especially true in the cases of middle-aged patients who have had no previous colon disturbance and in whom none of the features of mismanagement of the colon can be made out.

Diseases of the rectum and pelvic organs should be revealed in the routine examination, which all patients with abdominal complaints should have.

Treatment of the condition involves, first of all, an appreciation of the pathologic physiology involved. All treatment is directed toward there-establishment of normal physiology. The multiplicity of "trigger factors" of necessity leads the physician not only to drug therapy and dietetics, but psychiatry, economics, and sociology as well. The scheme of things must be sedative in type because of the nature of the disorder. Irritants of all types must be removed or ameliorated. With but few exceptions, there must be no compromise with the dictum of "no cathartics," however mild they are supposed to be. Mediocre results are the price of any lack of rigidity of purpose. The patient must be taught how to manage his bowel, he must understand enough gastro-intestinal physiology so that he can handle the ordinary variations in detail that come to any individual, and not do the wrong thing. At times it will tax the patience of any physician to attempt to correct the ideas that got the patient into trouble in the first place. Much of normality is so opposed to what has become traditional, and has been hammered into the popular mind by quacks and advertising, that it is no wonder it is hard to convince some people, that one is in line with the truth. The element of time enters in: a condition of months' or years' standing cannot be expected to subside quickly. Flare-ups during management are common, and are often of value as "horrible examples" in the

re-education of the patient. Gradually the victim learns and believes and thus most of the battle is won. Fortunately, even the most terrifically abused colon, if anatomically intact, can be quieted down and made to function normally on food alone.

MANAGEMENT

Diet—The diet may consist of ordinary bland food, with interdiction of those articles known to be possible irritants. Examples of potentially irritating articles of diet are coarse vegetables, as cabbage, corn, cucumbers, onions, radishes, cauliflower, baked beans, fruits—all raw fruits, with the possible exception of oranges and grapefruit, honey, cider, soft drinks, chocolate, syrups, beer, ale, and wine.

There are many individual reactions to articles of diet which must be worked out for each case. In many instances the patient is wrong in his interpretation of what causes trouble, but it is always best not to cross him when it can possibly be avoided—he may be right.

The diet should contain a sufficient quantity of non-irritating residue to produce a normal stool. At the start, this may be best accomplished by the use of those vegetables commonly fed to young children. In severe cases, they may be puréed, in all cases they should be well cooked.

Constipation must be understood to mean the passing of hard and dry stools. Absolute regularity is not insisted on. If the stools are constipated on a diet containing two ordinary helpings of vegetables, the quantity of vegetables is gradually increased to the point where the stool is no longer hard and dry. Distress, as a rule, lets up as the character of the stool approximates normal. If the stool is still hard and dry, and the patient can take no more vegetables, it is permissible to add fruit if there is no distress. Should there be a recurrence of distress following any addition of vegetables and fruit, it is usually wise to drop back to the former diet. The patient thus gradually works his way to what, for him, is a normal diet. Most patients can

SCHULLER-CHRISTIAN DISEASE

AFTER X-RAY THERAPY, LIVING AND UNDER OBSERVATION ELEVEN YEARS¹

By M. B. RADDING, M.D., *New York City*

Instructor of Radiology, New York University and Bellevue Hospital Medical College

THE case here described is the form of xanthomatosis (1), known as Schuller-Christian's disease, exhibiting "defects in the membranous bones, diabetes insipidus, and exophthalmos" (2). Rowland has shown that this disease belongs to the general group of lipid disturbances which include Niemann-Pick's, Goucher's disease, and cutaneous xanthomatosis. He believes it is a primary constitutional change affecting lipid metabolism, and perhaps a superimposed dysfunction of the liver and lungs resulting in excess accumulation of lipoids in the blood and body fluids, and then in massive storage or infiltration in the tissues. This he supports by findings in animal experimentation of cholesterol feeding. Our case belongs to that sub-group which is characterized by excess cholesterinemia, by occurrence in childhood usually between the ages of two and fifteen years, by defects in the flat bones, and a sequence of other signs depending on the location of the deposits. It is obvious that the deposition of the lipid and production of bone defects take precedence, and that a sequence of signs and symptoms appears as this process encroaches on other organs by pressure. Thus unilateral or asymmetrical exophthalmos, diabetes insipidus, dwarfism, or adiposogenitalis may follow. It is a progressive disease, occasionally showing spontaneous remission, and frequently being fatal within from two to four years. The patient here described is now 13 years of age, and his condition is apparently arrested. The case corroborates the findings of other writers (3), that the disease does not necessarily show the triad of Christian's syndrome simultaneously, but that the earliest of the



Fig. 1. Taken one year before the first symptom appeared, the patient was normal and well nourished.

three usually is bone defect. In this case the sign which directed attention to the bone lesion was a localized area of slight skin elevation on the left forehead. The report furthermore adds evidence to the efficacy of roentgen treatment in this disease.

CASE REPORT

Case 1. T. B., a white male child, aged 21 months, was first referred to me by Dr. Andrew J. McGowan, of New Brighton, N. Y., on June 20, 1923. The mother had observed the child putting its hand to the left frontal region where there was an area of scarcely perceptible elevation of the skin, about 2 cm. in diameter. In appearance it was soft and unchanged in color. The child was well nourished, normal in size and weight, and of good color. Figure 1 shows him about one year before examination.

¹ From the X-ray Department, St. Vincent's Hospital, Staten Island, N. Y.

Treatment of rectal pathology in some cases must precede any attempt to manage the colon

Finally, such commonsense matters as sufficient sleep, rest, outdoor exercise, water intake, posture, care of the teeth, etc., should be emphasized in the interest of removing all possible sources of irritation

Since, under normal conditions only the lower foot or so of the bowel empties with a normal movement, that segment is the only one we have a right to interfere with. Thus a stool may be induced legitimately by (1) a small plain water enema of 8 to 12 ounces, (2) a cocoa butter suppository, or (3) a three to four ounce olive oil enema. At times the oil enema is more effective if introduced at night and retained until morning. Leakage is often a nuisance, however. If a small water enema fails to get a result, it may be repeated, but no more than one pint should be used. Unless there is rectal discomfort, it is often better

to advise the use of the enema on the second day instead of daily

Exceptions to the use of laxative drugs, bran, mineral oil, etc., may be listed as follows: the aged, patients with organic nervous lesions, and temporary conditions such as perineal operations, hemorrhoidectomy, etc. When used, care should be exercised that the type of stool obtained is as close to normal as possible. In the event that soft stools are desirable post-operatively, the patient should be told of the reason for the use of mineral oil, etc., and advised concerning discontinuance of artificial aids to bowel movements later

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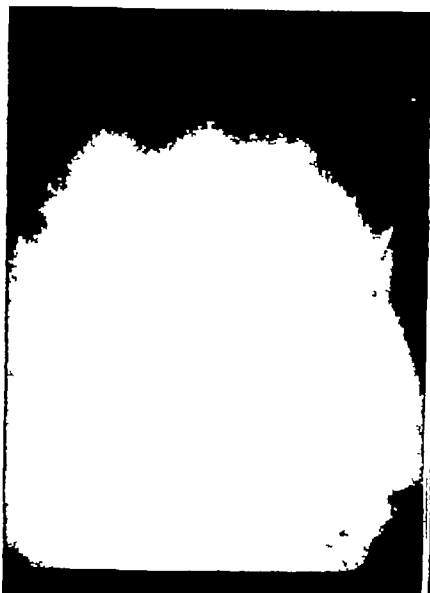


Fig 2 A

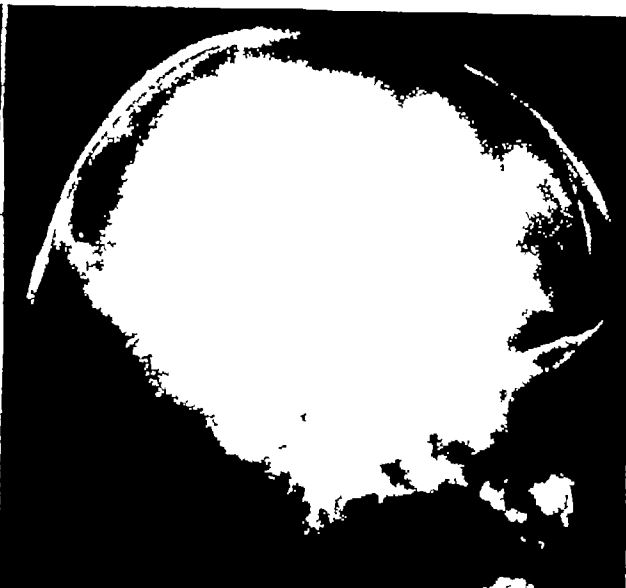


Fig 2-B

Figs 2 A and 2 B Single lesion in left frontal bone, films taken June 20, 1923

Both parents are Irish-American. He weighed 8 pounds at birth. His first teeth appeared at three to four months, he

Roentgenography showed a circular area of bone defect— 1.7×1.3 cm—in the left frontal bone, just anterior to the fronto-parietal suture (Figs 1-A and 1-B). The outline of this area was irregular. The sella turcica was normal in size and the clinoid processes intact. The teeth in the maxillæ were normal. The bones of the forearms and legs including their epiphyses, were normal. The blood Wassermann of the child was negative, and also that of the father and mother. At this time (1923), the child lacked the triad of signs described by Christian, in 1919. He did not have exophthalmos nor polyuria. A Von Pirquet test was found to be very strong. Since nutritional bone dyscrasias and syphilis were excluded, and no other evidences of disease were present, it was thought to be of tuberculous etiology and, therefore, no treatment except hygienic measures was advised. The mother reported that soon after she first brought the child to the hospital a "canker sore" had appeared on the left upper gum, and that the teeth had become loose, some of them having to be removed. The skin elevation on the left temple had disappeared in about four months without treatment.



Fig 3 A. Taken 18 months after Figures 2 A and 2 B. Exophthalmos was most marked in the left; there was a depression of the lower eyelid; double chin; mouth breathing (Jan 4, 1925).

walked at ten months, and had measles at six months.

The patient was not seen again until Dec 26, 1924, when he was re-admitted after an interval of one and one-half years, at which time he was three years and three months of age (Figs 3-A and 3-B)

Blood Wassermann was negative, blood urea nitrogen was 9 mg, calcium was 10.9 mg, phosphorus was 5.4 mg, and spinal fluid Wassermann was negative. A urinalysis revealed the following acid,

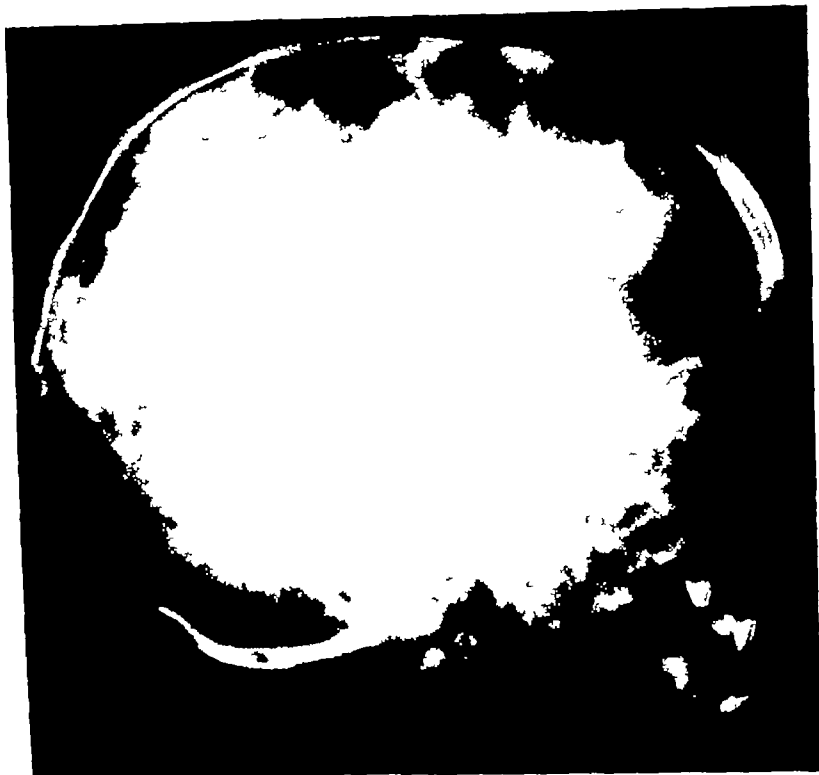


Fig 3 B Taken at the same time as Figure 3 A A 'geographic skull' with erosion of the sphenoid body and floor of the sella

A physical examination revealed an exophthalmos of both eyes, being most marked in the left. His teeth were loose, some extruding from the gums. There was mouth breathing, nasal obstruction, and drooling. The patient had a double chin and a pot belly. Temperature, pulse, and respiration were normal. The head presented no tumors, but irregular soft areas, some of them transmitting pulsations. Heart and lungs were normal, liver and spleen were normal. His blood count was: hemoglobin, 65 per cent, red cells 1,720,000, leukocytes 8,200, polymorphonuclears, 60 per cent, large lymphocytes, 10 per cent, small lymphocytes, 28 per cent. Red cells show no variation in size and shape, there were many with pale cen-

faint trace of protein, specific gravity, not obtained, no Bence-Jones protein (repeatedly negative later).

Roentgenography showed a very marked destruction of the bones of the vault, consisting for the most part of large coalescent areas of rarefaction of the typical "geographic" type, and of few small, discrete lesions. The areas were of irregular shape, and most of them had irregular, jagged outlines. The sella turcica showed changes in shape, its floor was interrupted, and its posterior portion was higher than its anterior. The body of the sphenoid bone showed absorption throughout, apparently due to the same process. The bone septa of the nasal sinuses were atrophic and irregular. The mandible showed the outlines of con-



Fig 2 A

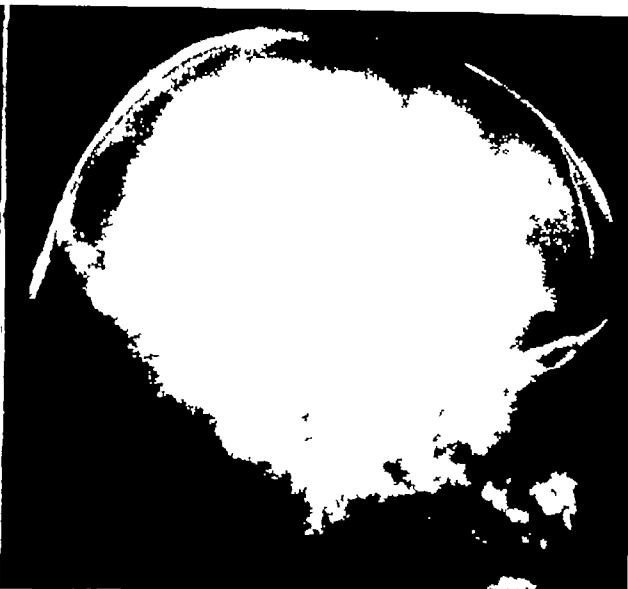


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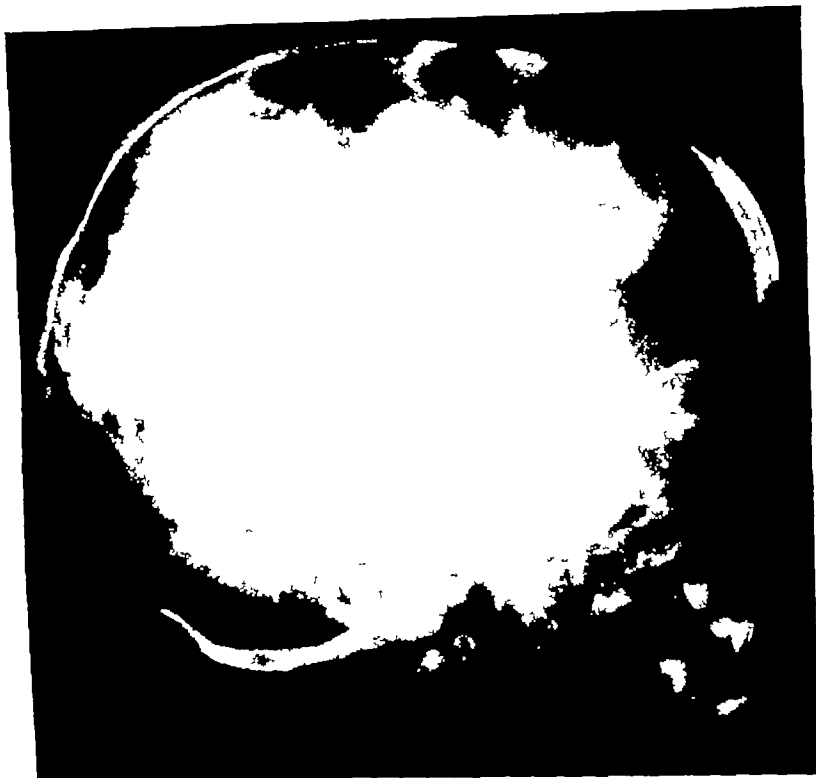


Fig 3 B Taken at the same time as Figure 3-A A 'geographic skull' with erosion of the sphenoid body and floor of the sella

A physical examination revealed an exophthalmos of both eyes, being most marked in the left. His teeth were loose, some extruding from the gums. There was mouth breathing, nasal obstruction, and drooling. The patient had a double chin and a pot belly. Temperature, pulse, and respiration were normal. The head presented no tumors, but irregular soft areas, some of them transmitting pulsations. Heart and lungs were normal, liver and spleen were normal. His blood count was hemoglobin, 65 per cent, red cells 1,720,000, leukocytes 8,200, polymorphonuclears, 60 per cent, large lymphocytes, 10 per cent, small lymphocytes, 28 per cent. Red cells show no variation in size and shape, there were many with pale cen-

ters. Blood Wassermann was negative, blood urea nitrogen was 9 mg, calcium was 10.9 mg, phosphorus was 5.4 mg, and spinal fluid Wassermann was negative. A urinalysis revealed the following acid,

Roentgenography showed a very marked destruction of the bones of the vault, consisting for the most part of large coalescent areas of rarefaction of the typical "geographic" type, and of few small, discrete lesions. The areas were of irregular shape, and most of them had irregular, jagged outlines. The sella turcica showed changes in shape, its floor was interrupted, and its posterior portion was higher than its anterior. The body of the sphenoid bone showed absorption throughout, apparently due to the same process. The bone septa of the nasal sinuses were atrophic and irregular. The mandible showed the outlines of con-

dyles and ramı, and of the inferior border of the body. Disalignment of the latter, in the anterior part, indicated fracture. The alveolar margins were not visible. The radiolucency within the body and ramı was

presented two small areas in its posterior part. Epiphyseal development at that time was normal.

Although Danzer's case (4), published a month earlier, called our attention to the

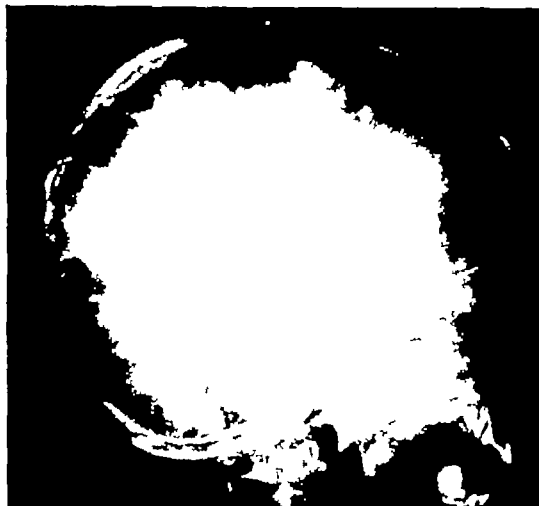


Fig 4 Taken six weeks after Figure 3 B. Pulsations were palpable.

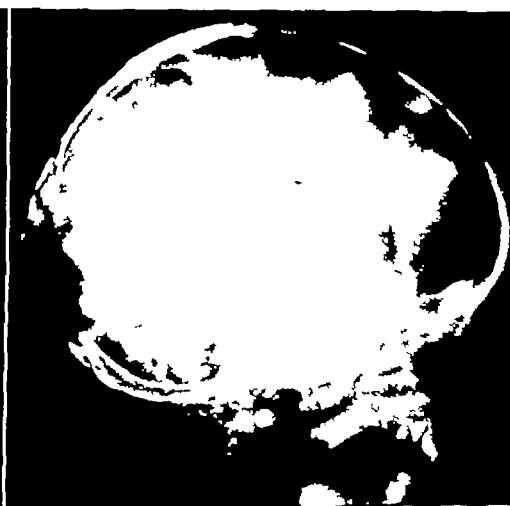


Fig 5 Taken five months after beginning of treatment (Oct 7 1925). There was marked improvement and an increased thickness of the mandibular border.

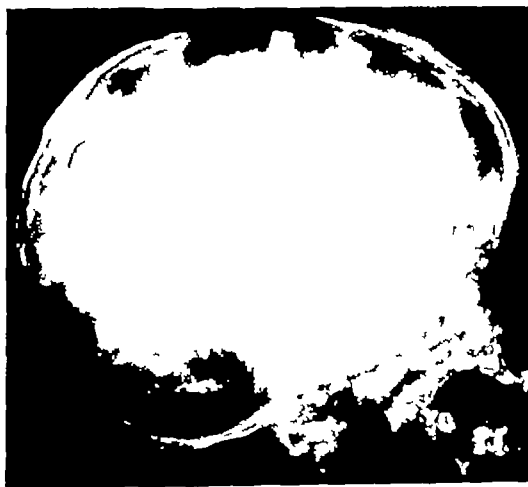


Fig 6 Taken at the onset of polyuria (May 24 1926).

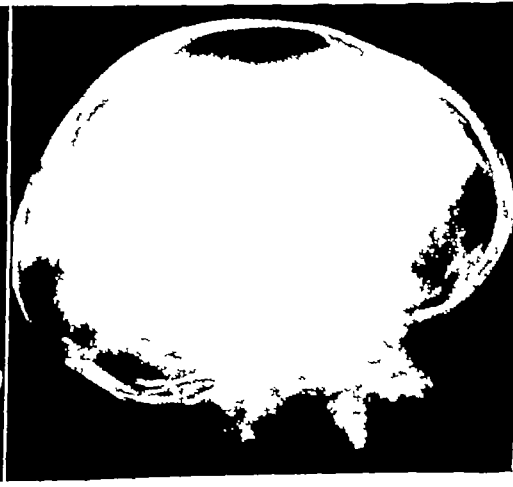


Fig 7 Taken three and one-half years after the beginning of treatment. There was still incomplete recalcification at the vertex and in the floor of the anterior fossa (Aug 1 1928).

suggestive of absorption of the same type as in the vault. The right iliac bone showed one irregular area, 2.2×1.3 centimeters. The third rib on the right side also

showed a similarity of our case to Christian's syndrome, it was not yet identified as such because our case did not have polyuria. Diabetes was then thought to be an essential

sign of that condition Therefore, it was concluded to be a form of myeloma or some obscure metastatic malignancy Dr James Ewing, after viewing the radiographs, advised against the taking of a biopsy and urged the institution of x-ray therapy

X-ray therapy treatment was begun on March 4, 1925, with the following factors 9-inch point spark gap, 5 ma, 10 inch distance, 4 mm Al filter, 4 or 5 minutes each With this set-up, 10 minutes gave an erythema The treatments were of relatively low voltage, and spaced about one month apart

Before treatment was begun, progression of the disease could be seen in an interval of six weeks (Fig 4) In some of the areas pulsations could now be felt About five

The discrete lesions were smaller, the large area in the temporo-fronto-parietal region showed considerable filling in The body of the sphenoid was also almost solid The sella turcica was altered in shape, its clinoid processes being absent However, some lesions at the top of the skull were more sharply defined, with smooth outlines, and through them pulsations were transmitted The mandible showed considerable improvement, with thicker, dense borders Also the septa of the nasal sinuses were denser

Polyuria was not noted until 14 months later (May 10, 1926), and persisted for 10 months During this period there was polydipsia, anemia, loss of appetite, and marked loss of weight, the latter decreasing from 35

TREATMENTS													
Skull						Ilium				Ribs			
Right	Min	Left	Min	Face	Min	Occip	Min	Ant	Min	Post	Min	Post	Min
3-4-25	4	3-6-25	4	3-11-25	4								
3-30-25	4	3-30-25	4										
(A)													
4-28-25	4	4-28-25	4	4-11-25	4	4-11-25	6						
6-8-25	4	6-8-25	4	5-16-25	5	5-16-25	5						
8-26-25	4	8-26-25	4	8-26-25	4								
(B)													
10-24-25	5	10-24-25	5	10-24-25	5			(J)					
(C)								10-9-25	5	10-9-25	5		
								12-23-25	5	12-23-25	5		
								2-18-26	5	2-18-26	5	1-27-26	5
								(K)					
(D)													
6-17-26	5	6-17-26	5										
		7-12-26	5										
12-23-26	5	12-23-26	5					(L)					
(E)													
1-25-27	5	1-25-27	5										
(F, G H I)						Vertex							
						2-25-27	5						

A—Epilation began 4-11-25 Hair has all grown in since

B—Improvement after 11 treatments to skull Sphenoid body filling in (Fig 5)

C—Enucleation of left eye, 11-13-25

D—Polyuria first noted 5-10-26

E—Polyuria decreased, 1-12-27

I—Polyuria subsided 3-18-27

G—Four months after last treatment to skull the parietal areas recalcified

H—Three and a half years after beginning treatment there is still incomplete recalcification at vertex and in floor of anterior fossa (Fig 7)

I—Figure 8 shows complete calcification 10-25-33

J—Ilium before treatment shows progression of the disease from 12-27-24 to 10-7-25 (Fig 11, A and B)

K—Nine months after treatment (Fig 11 C)

L—Eight years after treatment, (Fig 11 D)

months after the beginning of treatment (Oct 7 1925), during which time eleven applications had been given to the skull, there was marked improvement (Fig 5)

pounds to 27 When it ceased, the patient improved rapidly and gained six pounds in two weeks He had received 19 applications of x-ray to the skull before the onset

of diabetes, and eight more during its course

About two weeks after the onset of polyuria (May 24, 1926), there was a little more evidence of ossification in the vault

bones and mandible were short and small (Fig 8)

On Dec 27, 1924, the lesion in the right ilium was first demonstrated in the course of routine examination. It was 21×13



Fig 8 Complete recalcification at twelve years of age (Oct 25 1933)

lesions, but the area in the base of the anterior fossa was more marked and enlarged. The septa of the nasal sinuses were less dense, and the mandible showed decreased thickness of the dense borders (Fig 6). On Jan 12, 1927, polyuria was reported decreased, and was entirely absent by March 18, 1927.

When the patient was seen on Aug 1, 1928, there had been no recurrence of diabetes. There was apparent slight improvement of the exophthalmos since he was now able to close the eyelids (Fig 7). The lesions in the skull were well calcified except on the left side at the vertex, and to some extent at the base of the anterior fossa. At 12 years of age (Oct 25, 1933), there was complete calcification. Facial

mm along the outer anterior border, the border was intact, and the whole thickness of bone was not involved.

Ten months later, on Oct 7, 1925, just before treatment was begun on this area, it showed extension through the whole thickness of the bone and through the lateral border, measuring 26×16 millimeters.

On Nov 30, 1926, nine months after a series of six roentgen applications, there was definite evidence of some regeneration of the lateral border as well as increased density of all the border, and the size of the lesion was reduced to 19×7 mm (Fig 13).

Two and one-half years after the treatments, Aug 1, 1928, the lesion was almost completely filled in, there being a little

thinner triangular area 8×5 mm still visible

Apparently the progression of the lesion stopped at the time the treatment was given and the calcific replacement continued slowly thereafter. On Oct 25, 1933, at 12 years of age, the area was completely calcified (Fig 10)

In the third right rib, there were two areas 5 mm in length. These received one treatment on Jan 27, 1926. Ten months later the lesions were scarcely visible.

The exophthalmos of the left eye was so great before treatment was instituted that the eyelids could not be closed. This was slightly improved after 16 treatments to the skull had been given, so that the eyelids could be closed by voluntary effort. However, on Oct 24, 1925, the condition became aggravated, and the eye infected. Pus appeared in the anterior chamber. On Nov 13, 1925, enucleation was performed by Dr Charles W Kinney, who thought the condition was a retrobulbar sarcoma with superimposed infection. At operation he found no evidence of newgrowth, but the orbit was markedly contracted, and the upper posterior wall was pushed forward. Convalescence from this operation was uneventful. Five months later, the other eye was slightly inflamed and showed a corneal ulcer. Because of the patient's inability to close the eyelids, the cornea was exposed to irritation from the pillow during his sleep. At the suggestion of Dr John N Evans, of Brooklyn, the eyelids were kept closed at night by adhesive tape. The inflammation subsided, and the ulceration was checked. It is obvious that the acute condition in the left eye leading up to enucleation, had also been due to extrinsic irritation and infection. (See tables next column)

The patient is now 13 years of age, free of symptoms, and quite active. He attends school and plays vigorously with other children. He is considerably dwarfed, 51 inches in height and weighs 57 pounds (Fig 11). The right eye still shows exophthalmos. The mandible is under-developed as are also the facial bones. He shows no tendency to obesity. The gen-



Fig 9 Taken at the age of 12 a comparison of stature with that of a brother 18 months younger

Cholesterol examinations of the blood, made in 1933, were as follows

Feb 18, 1933	260 mg
July 8, 1933	300 mg
Oct 23, 1933	219 mg

Basal metabolism on Oct 20, 1933, was 70 below. Blood analysis on Oct 23, 1933, was as follows

Sugar	0.099 per cent
Urea N	8.4 mg per 100 cc
N P N	21.5 mg per 100 cc
Uric Acid	2.34 mg per 100 cc
Calcium	13.1 mg per 100 cc
Phosphorus	8.2 mg per 100 cc

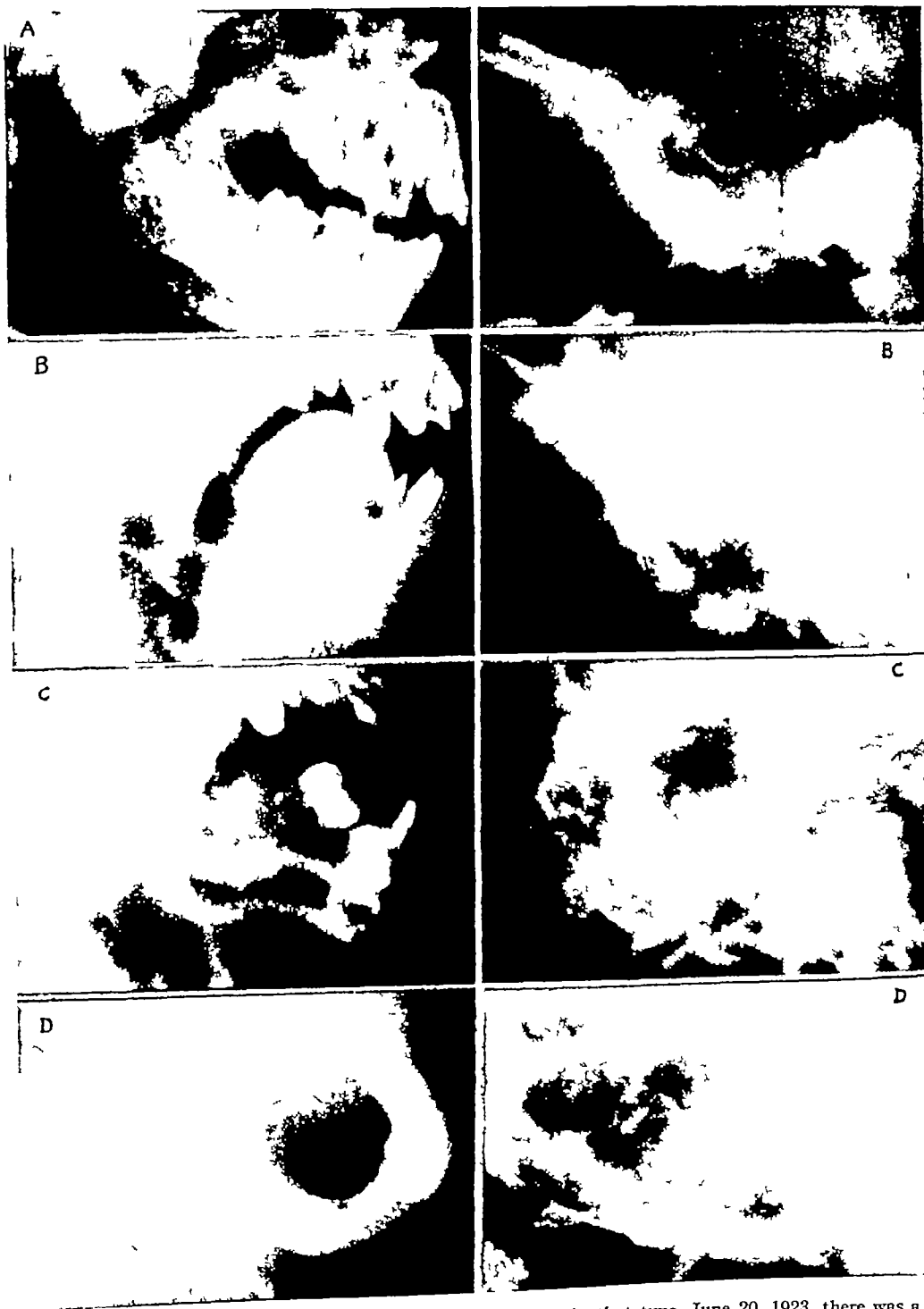


Fig 10 (A) Normal mandible, sella and sphenoid body. At that time, June 20, 1923, there was a single lesion in the skull. (B) There was a marked destruction in the mandible, the pathologic fracture probably accounting for the double chin. Some teeth may be seen extruding from the alveolus. The sphenoid body was eroded, the floor of the sella fractured(?) (Jan 4, 1925) same as Figure 3. (C) Improved sphenoid body, eroded floor of the sella fractured(?) (Jan 4, 1925) same as Figure 3. (D) Mandible completely recalcified but dwarfed. Sphenoid body well calcified (Oct 25, 1933).

tals are normal, but have not shown changes of puberty There is increased hirsutism on the forearms His long bones

ing roentgen therapy was at first not sufficiently convincing proof of the cause-and-effect relation, because of the length of time

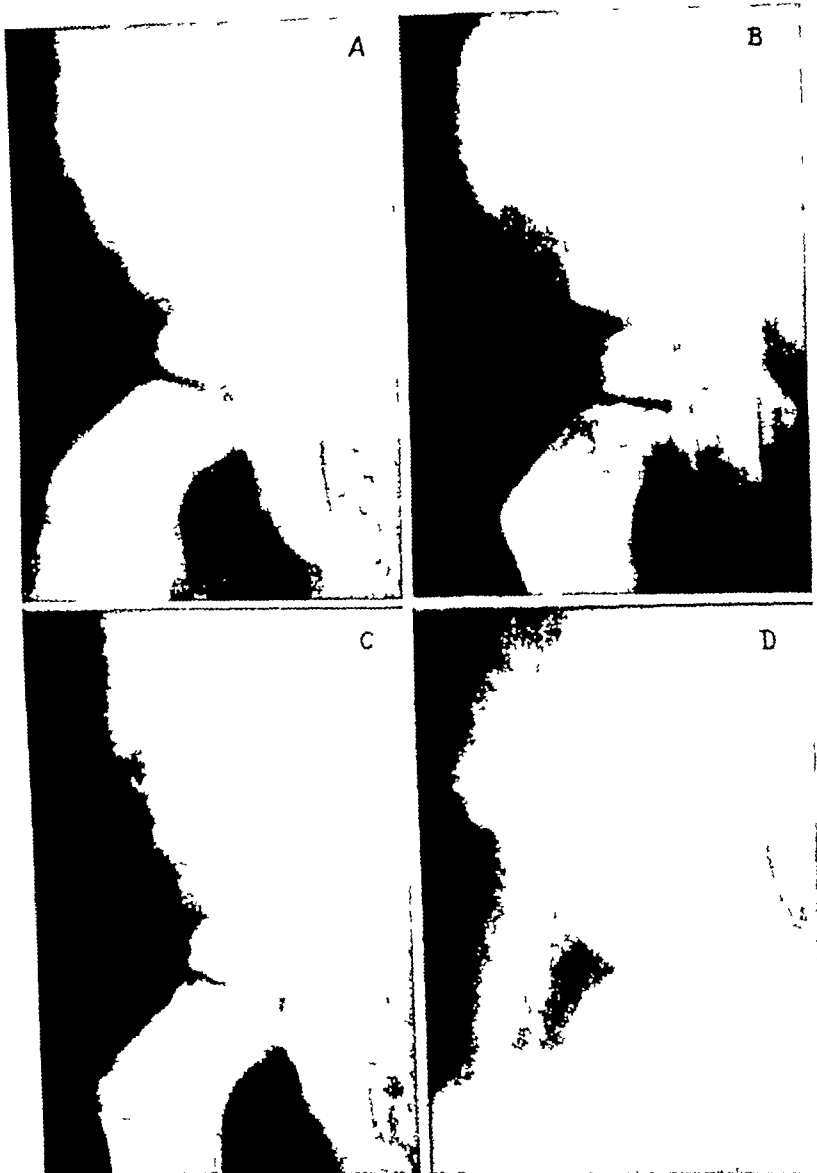


Fig 11 (A) Taken before treatment (Dec 27 1924) (B) Progression of disease during nine months before treatment (Oct 7, 1925) At this time the skull showed improvement after treatment (Fig 5) (C) Nine months after six treatments (Nov 30 1926) Definite limitation of lesion and some recalcification (D) Eight years after treatment (Oct 25 1933) with complete recalcification

are normal, but epiphyseal development is retarded about two years

DISCUSSION

Improvement in the bone lesions follow-

it took to recalcify the areas and because some areas remained uncalcified longer than others However, it was later apparent that the signs of improvement were evident the contour of each lesion was be-

coming even and there was cessation of expansion of the areas. The recalcification of the areas could be expected to be a slower process. The lesion in the ilium, which remained untreated during a period of nine months, showed definite progression of the destructive process, while in the same period the skull, which was receiving treatment, showed improvement. Furthermore, nine months after the ilium received treatment it also presented definite signs of improvement.

These evidences of the effect of roentgen therapy in this disease are similar to those obtained and convincingly demonstrated by Dr. Sosman in his cases (5). His bibliography and history of the evolution of this medical entity is very completely given (3).

In our case, all stages from the earliest to the most extensive have been seen. It is now well recognized that Christian's triad of signs is not essential in the diagnosis. A single small area of rarefaction, generally in the flat bones, and particularly in the mandible or the vault of the skull, may be the

earliest x-ray finding. Clinical signs may be present or may precede x-ray findings, e.g., ulceration of the gums, extrusion of teeth, and a chalky-white appearance of the teeth. Cholesterinemia should be looked for, x-ray therapy can be given as a test in doubtful cases. Later signs may be asymmetrical or unilateral exophthalmos, and soft areas in the skull, with or without pulsation. Polyuria may appear and may be transient. It is felt that if x-ray therapy is given early, loss of teeth, destruction of bone, and possibly diabetes and dwarfism may be prevented.

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TECHNIC FOR THE USE OF A SMALL CONE IN CHECK RADIOGRAPHS OF THE SPINE*

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SURGEONS and radiologists now require repeated x-ray examinations of a single fractured vertebra much more frequently than in the past. Many deem it necessary to observe the progress of healing and to make periodic checks of the position. The purpose of this paper is to describe a method of centering accurately for a designated vertebra when using a fine cone.

It is necessary to use the smallest cone possible in addition to the Bucky diaphragm to best visualize the minute bone detail in the bodies of the spinal vertebrae. The reproductions of spine films illustrating this article are examples. A routine x-ray examination of the lumbar spine (Fig 1)¹ was interpreted as only suspicious for a fracture of the body of the second lumbar vertebra. A check with a small cone (Fig 2) revealed undoubted compression fracture of this vertebra. Figure 3, a check five weeks later, shows satisfactory position and beginning callus formation. The anteroposterior view taken with a small cone (Fig 4) shows the line of fracture. In Figure 5, a routine anteroposterior view, the line of fracture was not visualized clearly enough to be reported.

The use of a fine cone is especially desirable when the patient is in a body cast, because the cast increases secondary radiation which diminishes contrast and, therefore, makes detail less visible. When the patient is in a cast it is impossible, unless the cast is very loose, to locate the point for centering by palpation of the spinous processes. This is difficult even when the patient is not in a cast. Some technicians overcome this difficulty by using the original anteroposterior view upon which to determine the distance of the designated vertebra from a landmark easily palpated,

* Read before the Colorado Society of X-ray Technicians, Nov. 14, 1933.

¹ Radiographs shown in Figures 1 to 6 were made at the Presbyterian Hospital, Denver, Colorado, by technicians Hébert Buchler, and the author.



Fig 1 Routine lateral lumbar spine. The diagnosis was not conclusive for fracture of the second lumbar vertebra.

such as the pubic symphysis, and mentally estimate the distortion present. This is



Fig 2



Fig 3



Fig 4

Fig 2 Same case as shown in Figure 1. Follow up lateral of second lumbar vertebra. Note increased visualization of detail resulting from the use of a fine cone. Compare with Figure 1. The line of condensation indicates compression fracture.

Fig 3 Check on the same case as shown in Figures 1 and 2 five weeks later reveals satisfactory position and some callus formation. Callus would hardly be visible without the definition caused by a small cone.

Fig 4 Follow up anteroposterior of case shown above, made with a dental cone. Compare with Figure 5, and note the increase in clarity of bone architecture.

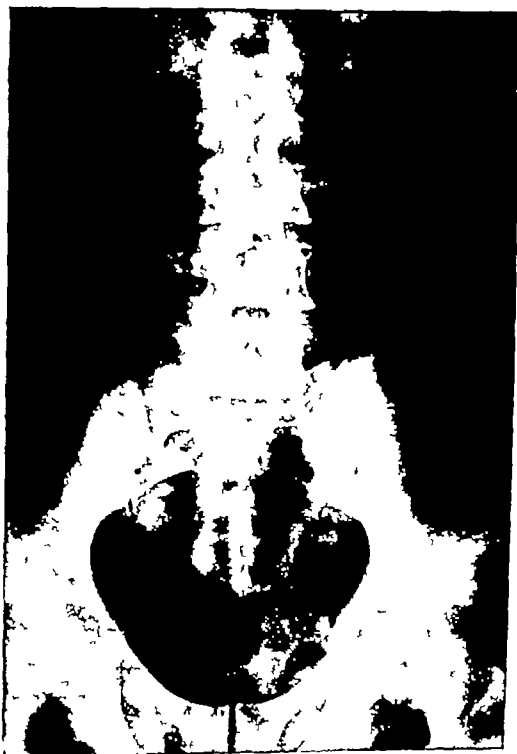


Fig 5 Routine anteroposterior view of case shown in Figure 4. Compare the detail of these two radiographs.

obviously inaccurate. Now that high milli-ampere-seconds and low kilovoltage are used in radiography to produce maximum contrast, repeated examinations which fail to visualize the proper vertebra must be kept at a minimum because of the effect on the skin.

The method to be described determines accurately the amount of distortion present, it requires a chart which can be made easily by the x-ray technician (Fig 6). The numbers on the chart are empirical. The base-line, *A*, represents the lateral profile of a cassette 17 inches long. The numbers on line *D* represent the distance in inches from the cassette toward the x-ray tube. A chart of convenient size is made by electing the scale "one-half inch equals one inch." The position of the x-ray tube is represented by *T*, and a line straight down from the tube, *D*, corresponds with the central ray, this line bisects the base-line, *A*, at *X*. *B* indicates the surface of the Bucky diaphragm. The empirical units on the base-line denote the distances from this point (*X*) toward the edges of the cassette. The lines *Y* and *Z* represent movable strings

used to indicate oblique rays from the x-ray tube. In making the chart, attach the strings to line *D* at the number representing

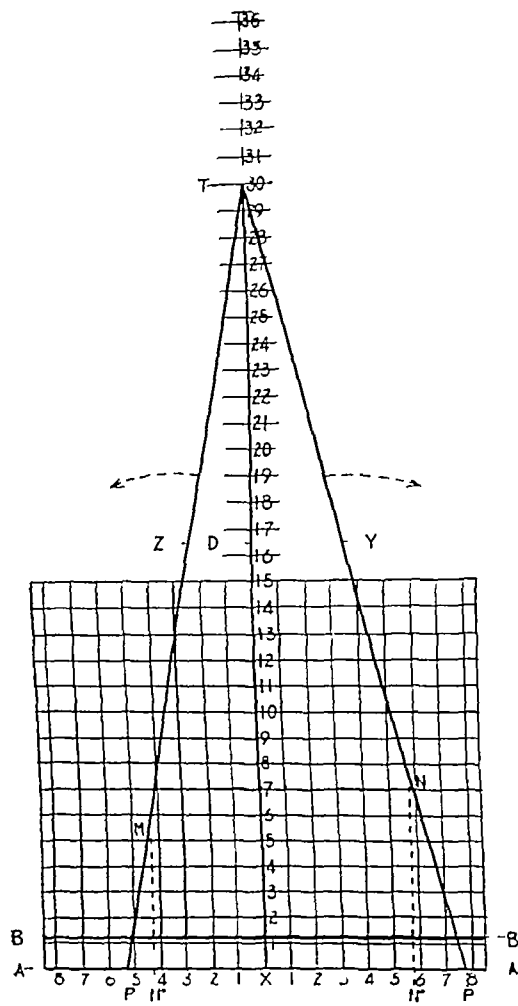


Fig 6 Chart for computing distortion Numbers are empirical units (*A*) lateral profile of plate, (*D*) distance from cassette toward tube, (*T*) \times ray tube, (*Y* and *Z*) movable strings, (*B*) surface of the Bucky, (*M'N'*) actual size of object, (*PP*) size of the \times ray image

the target-plate distance used on the anteroposterior spine plate

This chart furnishes a method of precision for a common radiographic practice. It is merely a diagram of the practice of using a yardstick or an imaginary line along which to sight from the tube to the cassette through a desired body landmark, to assure its visualization at a given location on the film (Fig 7)

Throughout this explanation of the procedure of using the chart, visualize the patient as lying supine on the Bucky diaphragm as when centered for an anteroposterior view of the spine (Fig 7)

At the time the first anteroposterior radiograph is made, measure and record the

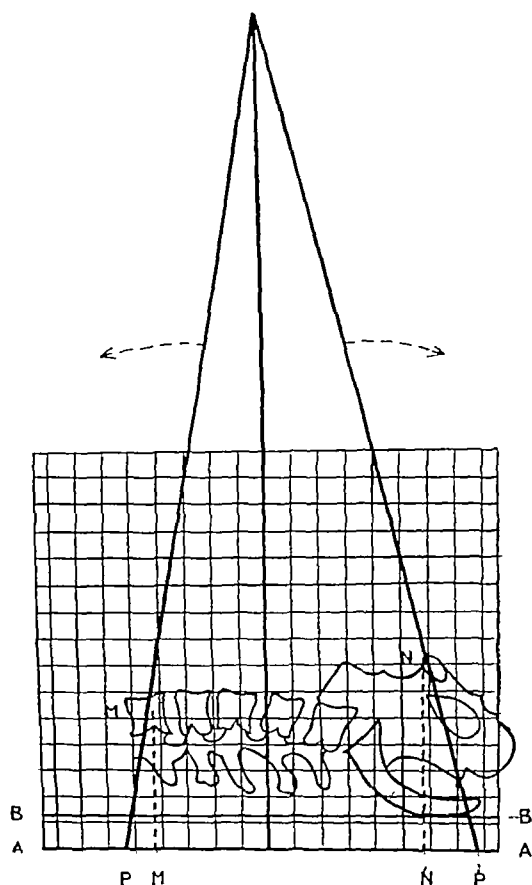


Fig 7 This illustrates the same chart as shown in Figure 6 with the spine drawn in to show how objects are distorted when the Bucky diaphragm, which increases object plate distance, is used! (A) lateral profile of plate, (B) surface of Bucky (M'N') actual size of object, (PP) size of the x ray image

perpendicular distance from the patient's pubic symphysis to the cassette. This is a landmark rarely covered by a cast

If a check examination is ordered, place the anteroposterior film made at the first examination on a view box, and mark on the spine a point equidistant from the upper and lower edges of the film. Figure S shows this point marked X, it corresponds with A on the chart (Fig 6). Now



Fig 8 Anteroposterior view showing measurements to be transferred to the base line of the chart (Fig 6)

measure on the plate the distance from this point to the pubic symphysis, which in this

is to be x-rayed) Now using the chart, move string (represented by line Y, Figure 6) to the empirical number of the base-line which designates the distance in inches (seven and three-fourths) that the top of the pubic symphysis was below X on the anteroposterior plate (Fig 8) Now locate on line D the actual distance (measured and recorded at the time of the first examination) from the pubic symphysis to the cassette (seven and one-fourth inches) Fasten a thumb tack on the chart where the string crosses this level (See N, Figures 6 and 7) This represents the location of the pubic symphysis at the time of the first anteroposterior radiograph

On the anteroposterior plate previously used, now measure the distance from the center of the body of the desired vertebra to point X (the first lumbar was five and one-fourth inches) Again using the chart, move string, Z, along the base-line five and one-fourth units from the center on the opposite side of X, from which string Y was placed Just as it is necessary to know the distance from the symphysis to the cassette to determine point N, it is necessary to know the distance from the designated vertebra to the cassette when the patient is supine to determine point M The former was measured on the patient For the lat-



Fig 9 Routine lateral view used for an estimation of vertebra-cassette distance The horizontal line B, represents the table top

case was seven and three-fourths inches (7 3/4 inches) First lumbar vertebra

ter measurement the original lateral view may be utilized Place this plate crosswise

on a view box with the spinous processes down. Draw a line on the film at the posterior edge (inferior aspect when the film is

and one-fourth inches². Transfer this sum to the chart on line *D*. Fasten a thumb tack on the chart where the string crosses

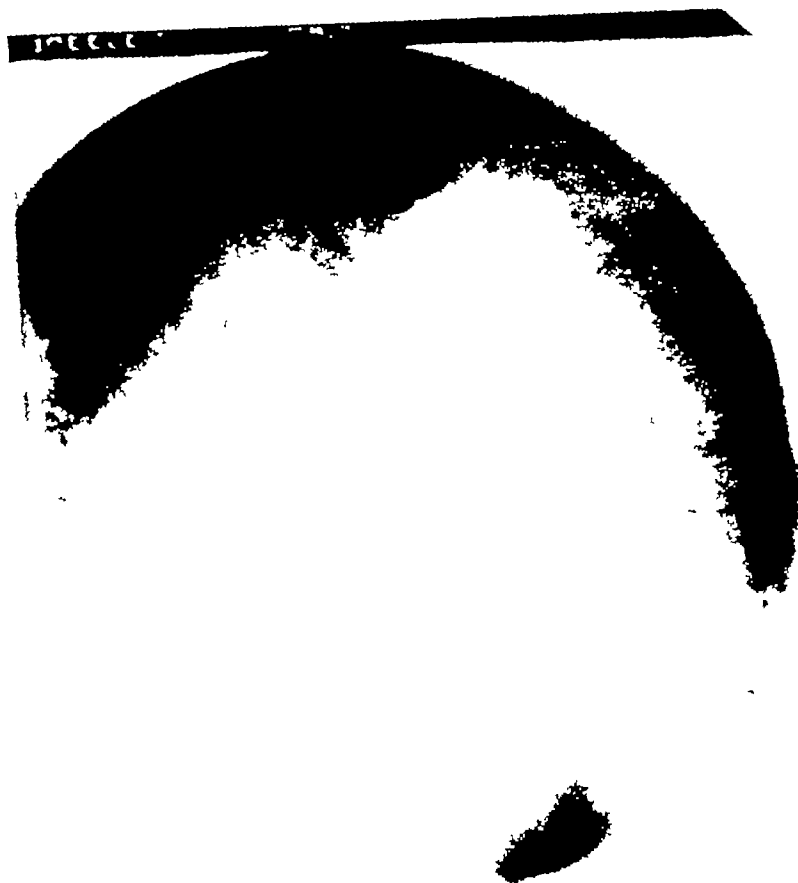


FIG. 11. Chart through cast with fine cone illustrating a result obtained by the use of the method described in the text.

crosswise of visibility of the soft tissues which is virtually the plane of the table top. This view therefore is the equivalent to the lateral profile of the patient while lying on a table in the supine posture. Measure the distance of the center of the body of the designated vertebra from the Bucky table. (See Figure 9). *B* represents the surface of the Bucky. To this distance add the distance from the top of the Bucky table to the cassette.² In this example 10.4 inches plus one and one-fourth inches equal five

this level. (See *M* Figures 6 and 7.) This represents the position of the vertebra on the chart.

The next procedure is to drop a perpendicular from *M* and *N* to the base-line, and establish points *M'* and *N'* on the base-line. *N* is five and three-fourths inches from *X* since the numbers empirically represent inches accordingly *M* is four and one-fourth inches from *X*. Five and three-fourths inches plus four and one-fourth inches equal ten inches. This is the *actual* distance on the patient from the pubic

² This distance can be obtained from the manufacturer's Bucky diagram and a curve will be obtained in all cases varied only in scale.

The error caused by the error in this short measurement is not significant.



Fig 8 Anteroposterior view, showing measurements to be transferred to the base line of the chart (Fig 6)

measure on the plate the distance from this point to the pubic symphysis, which in this

is to be x-rayed) Now using the chart, move string (represented by line *Y*, Figure 6) to the empirical number of the base-line which designates the distance in inches (seven and three-fourths) that the top of the pubic symphysis was below *X* on the anteroposterior plate (Fig 8) Now locate on line *D* the actual distance (measured and recorded at the time of the first examination) from the pubic symphysis to the cassette (seven and one-fourth inches) Fasten a thumb tack on the chart where the string crosses this level (See *N*, Figures 6 and 7) This represents the location of the pubic symphysis at the time of the first anteroposterior radiograph

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ROENTGEN ASPECTS OF SYMPATHETIC NEUROBLASTOMA

WITH REPORT OF TWO CASES

By ADOLPH HARTUNG, M D , and SAMUEL R. RUBERT, M D , *Chicago*¹

From the Department of Radiology, University of Illinois, College of Medicine

REPORTS of tumors arising in various locations from the cells of the sympathetic nervous system, with variations in terms and classifications, have appeared in the literature from time to time since Wright (1), in 1910, first recognized

called the Pepper type. The cases presenting diffuse metastases to the skull, orbit, and long bones, and not limited to the abdomen, have been called the Hutchison type. Numerous reports subsequent to the original descriptions by Pepper (2) and by

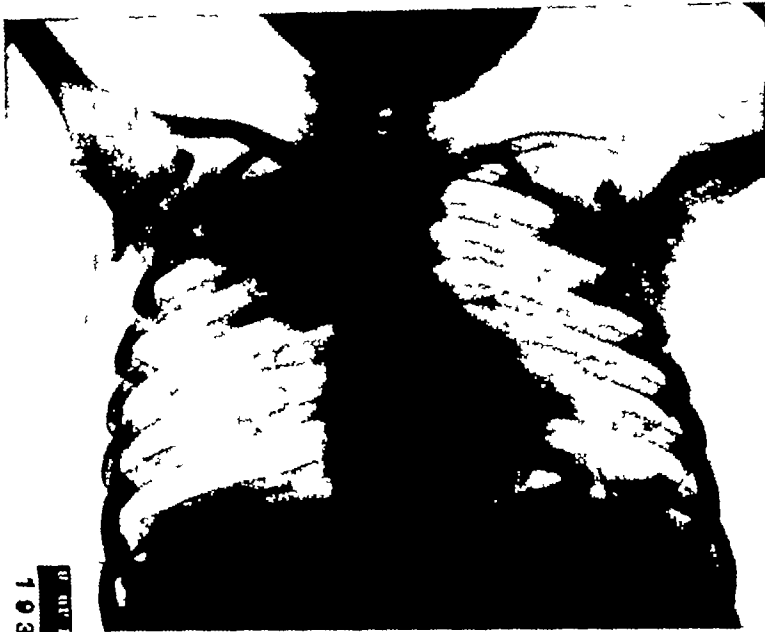


Fig 1 Case 1 Localized density in right apex representing neurocytoma tumor from which metastases originated

the neurogenic nature of these neoplasms and applied the term neuroblastoma to them. They are also commonly referred to as sympathetico-blastoma and neurocytoma. Two different tumor types have been described. Those cases limited to the abdomen with metastases to the liver from an original site in the adrenal have been

Hutchison (3) show such a classification to be without foundation, and that diffuse metastases to the bones and glands may occur in all cases.

This paper is presented to add two cases of sympathetic neuroblastoma of cervical sympathetic origin to the literature. The roentgen data associated with them were of particular interest from both the diagnostic and therapeutic viewpoints, justifying a detailed discussion of the findings.

Sympathetic neuroblastomas are found most commonly in infants and young chil-

¹ We wish to express our appreciation to Dr. Julius H. Hess and Dr. H. G. Poncher for the pediatric courtesy in allowing the report of these cases from their service at the Research and Educational Hospital of the University of Illinois.

symphysis to the point on the longitudinal axis of the patient, at which to center to depict the involved vertebra. The centering point along the horizontal (crosswise) axis is selected in the routine manner. Note that on the anteroposterior *film* this distance is 13 inches. Thus, the distortion in this case is three inches. The chart automatically computes and allows for this distortion.

When a vertebra in the thoracic spine is designated, the intraclavicular notch may be used as a landmark instead of the pubic symphysis. If plates of the lower dorsal and upper lumbar spine are requested, and neither of these landmarks appear on the film, place a small marker on the patient's abdomen a known distance (recorded for future reference) from the pubic symphysis. This can be used as a landmark for chart calculations. At the time of the check examination, again make use of the pubic symphysis for determining the centering point on the patient, by merely adding the formerly recorded distance from the landmark to the pubic symphysis.

This method without modification may be used in cases of moderate scoliosis. Cas-

ettes 7 by 17 inches are becoming popular. When one of these is used for the lateral view, center at a point to assure visualization of the spinous processes. Any error caused by lateral stereoscopy is insignificant and may be ignored.

Though the description of this method may seem complicated at first reading, once used it proves to be simple and practical. It will be noted that it requires only four measurements from a routine examination transferred to a chart. Figure 10 illustrates a radiographic result of the practical use of this method. The radiograph was made through a heavy body cast and the desired vertebral body is almost exactly centered.

SUMMARY

- 1 Follow-up examinations of a single fractured vertebra require the use of a small cone and are being more frequently requested.

- 2 The literature does not present a method for centering a single designated vertebra in follow-up examinations.

- 3 A simple method for accomplishing this is described.

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From the Department of Radiology, University of Illinois, College of Medicine

REPORTS of tumors arising in various locations from the cells of the sympathetic nervous system, with variations in terms and classifications, have appeared in the literature from time to time since Wright (1), in 1910, first recognized

called the Pepper type. The cases presenting diffuse metastases to the skull, orbit, and long bones, and not limited to the abdomen, have been called the Hutchison type. Numerous reports subsequent to the original descriptions by Pepper (2) and by



Fig 1 Case 1 Localized density in right apex representing neurocytoma tumor from which metastases originated

the neurogenic nature of these neoplasms and applied the term neuroblastoma to them. They are also commonly referred to as sympathetico-blastoma and neurocytoma. Two different tumor types have been described. Those cases limited to the abdomen with metastases to the liver from an original site in the adrenal have been

Hutchison (3) show such a classification to be without foundation, and that diffuse metastases to the bones and glands may occur in all cases.

This paper is presented to add two cases of sympathetic neuroblastoma of cervical sympathetic origin to the literature. The roentgen data associated with them were of particular interest from both the diagnostic and therapeutic viewpoints, justifying a detailed discussion of the findings.

Sympathetic neuroblastomas are found most commonly in infants and young chil-

¹ We wish to express our appreciation to Dr. Julius H. Hess and Dr. H. G. Poncher for the pediatric courtesy in allowing the report of these cases from their service at the Research and Educational Hospital of the University of Illinois.

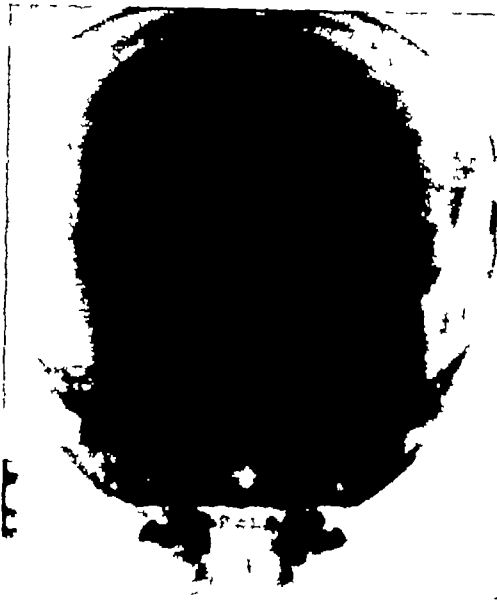


Fig 2 Case 1 Blurred orbital outline on left side and diastasis of sutures



Fig 3 Case 1 Sawtooth like indentations of outer table of skull, marked separation of sutures and increased digital markings

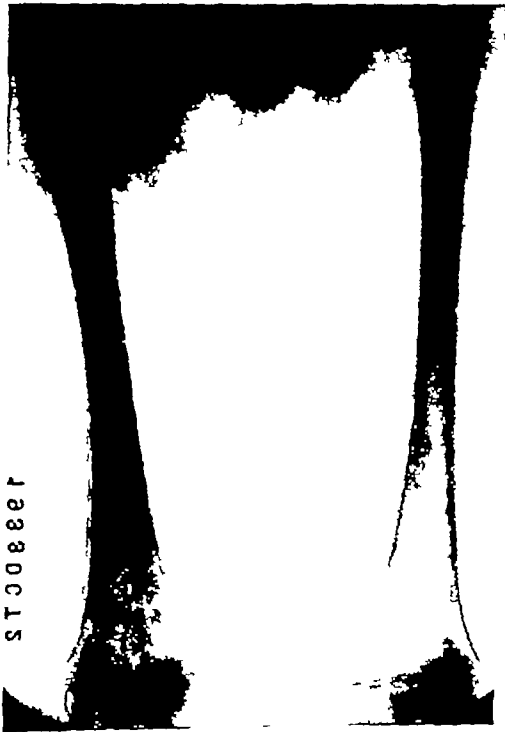


Fig 4 Case 1 Elevation of periosteum, with new bone formation along shafts Irregular decalcification of lower end of both shafts and upper end of left shaft

Increased recognition of these tumors in various locations has shown that they may arise from the cells of the sympathetic nervous system without special predilection for site Scott, Oliver, and Oliver (4) tabulate a total of 162 reported cases arising in the medulla of the adrenal glands Scott and Palmer (5) suggest a classification based on descriptive names, following the lines of embryologic development, and tabulate the reported cases arising from the sympathetic trunk exclusive of those arising within the medulla of the adrenal glands The cervical sympathetic trunk is given as the original site of the tumor in but four of the 37 cases that are listed by them The others have their origin in various parts such as the abdominal sympathetic, thoracic sympathetic, coccygeal gland, celiac ganglion, mesentery, jejunum, liver, uterus, cavity of the nose, skin, paravertebral region, spinal canal (extradural), and the scapular region

The gross appearance of the tumor varies somewhat with the location, and presents itself as a soft hemorrhagic mass The cut surface has a white or gray appearance, with necrosis and localized hemorrhagic areas When it occurs in the adrenals there

dren but also appear in adults, and occur with about equal frequency in both sexes

is destruction of the medulla with involvement of the cortex. Secondary metastatic nodules resembling the original tumor ap-

In exceptional cases, the primary lesion may be demonstrated roentgenographically as a tumor mass, as in the cases to be re-

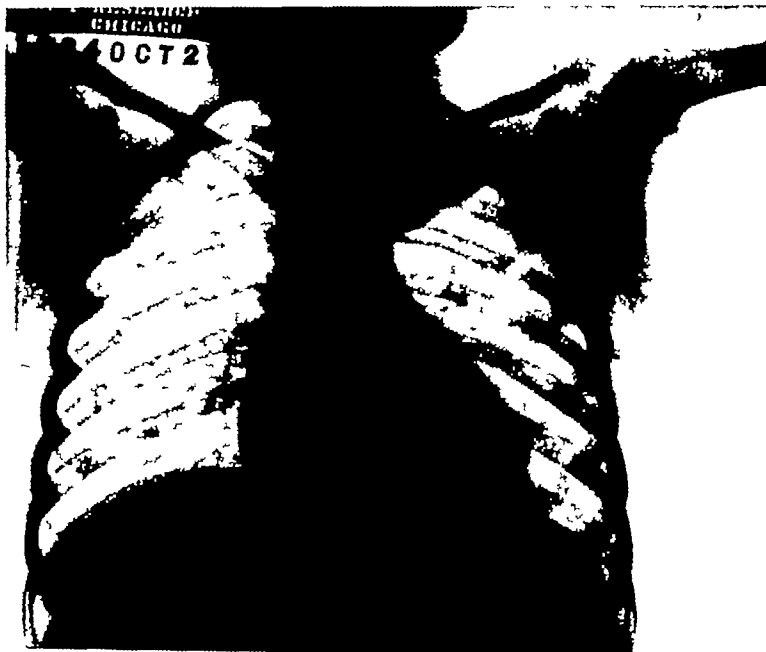


Fig 5 Case 2 Circumscribed density in left apex representing original tumor

pear in the regional lymph glands, liver, and other tissues, including the bones.

Microscopically, the tumor is highly cellular, presenting a fibrillar matrix with the cells usually forming rosettes about bundles of fibrillæ. The characteristic cell resembles the primitive migratory cell of the sympathetic nervous system.

The earliest symptoms are usually those resulting from the metastases to the skull and orbit, nodular swellings occur, with progressive proptosis of the eye and surrounding discoloration. Similar nodules may also be present in other parts, such as the cervical region and axilla. A palpable abdominal tumor may be present, pain in the bones and joints also occurs.

The roentgen examination may give valuable aid in arriving at a diagnosis. Holmes and Dresser (6), Henle (7), Lederer (8) and Sturtevant and Kelly (9) have included descriptions of such findings in connection with cases reported by them.

ported by us. Usually the findings are limited to changes occurring in connection with the metastases involving the bones. In the long bones these manifest themselves as elevations of the periosteum, due to metastatic tumor infiltrations underneath it along the shaft, or tumor cell infiltrations in the bone. Involvement of the skull seems to be especially common, presenting sawtooth-like defects on the outer table probably due to similar metastatic deposits. There may also be invasion or erosion from adjacent lesions in the soft tissues. Diastasis of the sutures and increased digital markings on the inner table may occur, suggestive of increased intracranial pressure, without demonstrable intracranial or meningeal metastases.

The clinical course is rapidly downhill, with the presenting symptoms becoming more pronounced and progressively worse, with fatal termination.

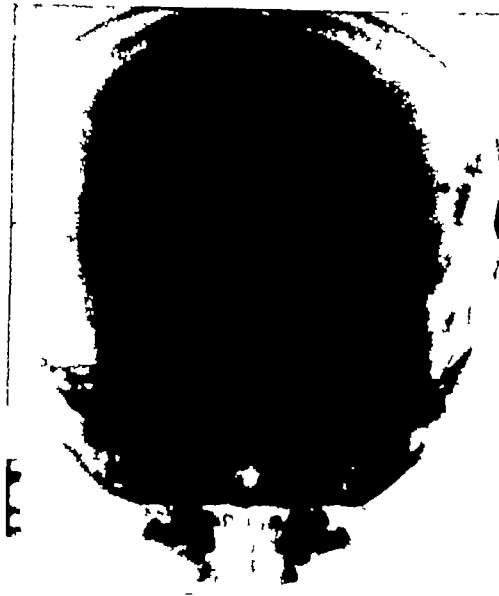


Fig 2 Case 1 Blurred orbital outline on left side and diastasis of sutures

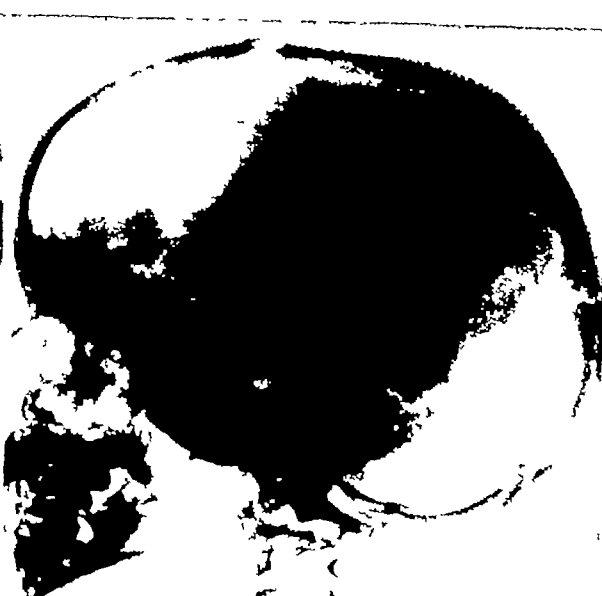


Fig 3 Case 1 Sawtooth like indentations of outer table of skull marked separation of sutures and increased digital markings

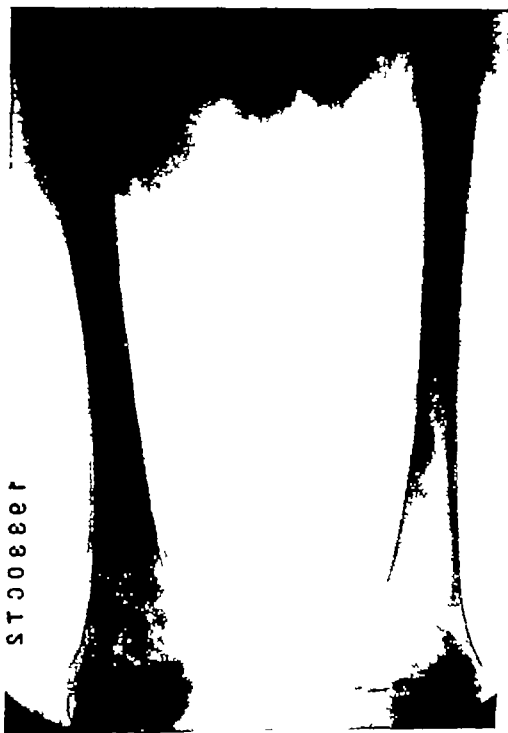


Fig 4 Case 1 Elevation of periosteum with new bone formation along shafts Irregular decalcification of lower end of both shafts and upper end of left shaft

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mission, followed by progressive swelling, discoloration, and bulging of the eye. Except for occasional fainting spells, the past

murmur was present. The abdomen presented prominence of the veins, and the liver was palpable one finger beneath the



Fig 7 Case 2 Ray-like calcareous deposits projecting from outer table of skull with irregular mottled decalcification and marked widening of sutures

history revealed no information pertinent to the existing condition.

Physical examination revealed a poorly nourished and somewhat underdeveloped child, not acutely ill, who appeared to be quite comfortable and alert. Pallor of the skin and mucous membranes, and flabbiness of the muscles were present. There was also marked proptosis of the left eye, with purplish discoloration of the eyelid, and edema of the conjunctiva. The left pupil was larger than the right, and was sluggish in its reaction to light and accommodation. A firm round tumor mass was present in the right occipito-parietal region, with a few glands in the cervical region. No definite lung findings were present. Percussion and auscultation signs were of a questionable nature, even after the demonstration on roentgenograms of a definite tumor mass in the right apex. The heart was enlarged to the left and a systolic

costal margin, spleen and kidney were not palpable. The tendon reflexes were normal and sensation was intact. The fundus examination showed the presence of an optic neuritis.

A provisional diagnosis of neurocytoma was made on the basis of the findings of proptosis and palpable nodules in the skull. The possibilities of sarcoma and chloroma were also considered.

Laboratory findings were as follows. Urinalysis and Mantoux and Kahn tests were negative. Blood examinations upon entrance revealed the presence of a high grade anemia. Subsequent examinations gave no additional findings of positive value.

Roentgen examinations revealed the following. On July 14, films made of the head showed a slight increase in the digital markings of the skull, and well marked separation of the sutures, especially the coronal,



Fig 6 Case 2 Marked widening of sutures with enlargement of skull and irregular mottled decalcification

The clinical manifestations together with the roentgen findings justify a presumptive diagnosis of the condition, but the ultimate diagnosis usually rests upon biopsy confirmation. Differential diagnosis is largely a matter of exclusion, depending on the site of the original lesion, stage of development, and location and extent of the metastases at the time the case comes under observation. The progressive nature of the condition, course, lack of characteristic laboratory findings, and complexity of reaction serve to differentiate it in most instances from diseases with which it might be confused in certain stages of its development, such as rheumatic fever, leukemia, or even sinusitis.

The roentgen findings associated with bone involvement may be simulated by a variety of conditions from which they may have to be differentiated. Christian-Schuller's disease is characterized by sharply circumscribed multiple defects of the bone, most commonly limited to the skull, but which may involve the long bones, with no associated periosteal reac-

tion or elevation, and without evidences of increased intracranial pressure. When involvement of the bones occurs in Niemann-Pick's and Gaucher's diseases, the findings are limited to infiltrations into the substance of the long bones. These diseases are characterized also by an associated spleno-hepatomegaly and characteristic blood findings. In erythroblastic anemia, sawtooth-like indentations of the outer table of the skull may simulate those of neurocytoma, but other bone changes are usually absent, and a characteristic blood picture is present. Cortical and diffuse subperiosteal infiltrations with periosteal elevation may occur in the leukemias, but the associated blood picture readily discloses the nature of the lesion. A positive serum reaction and the presence of osteochondritis usually identify syphilis. Scurvy presents subperiosteal hemorrhage, with possible displacement of the epiphyses without cortical involvement. In chloroma, the findings about the orbit and skull may be confusing, and differentiation depends on the greenish discoloration that occurs in these cases. Where involvement of the long bones occurs, there is no associated periosteal reaction. Sarcoma and endothelioma may give confusing skull findings, but these are isolated single lesions. In cases in which intracranial neoplasms result in marked diastasis of the sutures, and possible bone erosion, the accompanying neurologic findings usually serve to differentiate them.

Therapeutic measures used have generally been found to be of little avail. Hauser (10) calls attention to the radiosensitivity of the tumor, and reports satisfactory results with regression of the lesion treated. Boyd (11), Kwartin and Twiss (12), and Holmes and Dresser report disappointing results from roentgen therapy, which is similar to our experience.

CASE REPORTS

Case 1 P W, a female, five years of age, entered the hospital on July 13, 1933, with a history of traumatic injury to the left eye six and one-half weeks prior to ad-

findings There was involvement of the peri-aortic and cervical lymph nodes, and the ovaries and liver were largely involved and replaced by tumor cells

The lungs lay free in the pleural cavity, and a fluctuant tumor mass about $5 \times 6 \times 3.5$ cm was present behind the pleura in the region of the right apex. One of the right cervical roots extended into it and the sympathetic chain could be partially traced behind it. The cut surface of the tumor revealed a firm gray border area around a rather sharply circumscribed cavity filled with a gummous gray material.

The ribs presented numerous tumor infiltrations immediately beneath the periosteum near the vertebral ends and at the costochondral junctions. Similar subperiosteal metastases were present along the shafts of the femora and also in the skull, where they formed infiltrating nodules of variable size continuous with the tumor masses noted at the vertex and in the left orbit. Metastatic nodules were also present along the lateral borders of the bodies of the lumbar vertebrae.

The calvarium was studded with pale gray to dark red nodules of rubbery consistency, which caused a roughening of the bone beneath them, but no erosion. The dura in the occipital region was displaced by a tumor which extended through the skull but did not involve the dura. The convolutions in the brain were flattened, suggestive of increased intracranial pressure.

Microscopic sections of the intrathoracic tumor showed it to contain an irregular fibrous stroma within which rounded cells, moderately variable in size, were clustered in rosette arrangement about the smaller blood vessels, and irregularly distributed in the interstices of the stroma. These cells contained a small amount of granular cytoplasm, with pink staining and poorly defined cell margins, and fibrillar projections extending from a stellate base. The nuclei were rounded or slightly irregular in outline. The chromatin formed a rather dense band about the margin and was distributed through the nucleus in irregular reticular,

and in some instances granular, arrangement, allowing vacuolar spaces between Nucleoli, deeply stained and small, were present in most of the cells. Some mitotic figures were present. In many areas the tumor tissue was broken down, with the formation of a fibrinous granular debris containing some nuclear remains. Similar findings were noted in the metastases examined.

The pathologic diagnosis was a primary neurocytoma, arising about the region of the sixth cervical root, with widespread metastases.

Case 2 S. G., a female, five years of age, entered the hospital on Oct. 17, 1934, with a history of transient pain in various joints over a period of two months, not associated with fever or edema, and resistant to medication. Two weeks prior to admission, the patient suddenly developed a progressive swelling over the right orbit, with proptosis of the eye. Past history gave no other information pertinent to the existing condition.

Physical examination revealed a pale, irritable, well nourished child, not acutely ill. A fluctuant tumor mass was present over the right orbit which was not tender and appeared to be fixed to the underlying bone, the skin was not adherent over it. Proptosis of the eye was present, without discoloration of the lid and surrounding tissue, and edema of the conjunctiva. A small palpable tumor mass was also present in the right postauricular region, and glands were palpable in the cervical region and in both axillae. The chest, abdomen, and extremities presented no positive findings.

In view of the experience with the preceding case, a provisional diagnosis of neurocytoma was made on the basis of the presence of supra-orbital swelling, multiple palpable glands, and roentgen findings. Biopsy of one of the glands of the axilla confirmed the diagnosis.

Laboratory findings were as follows. Urinalysis and Mantoux and Kahn tests were negative. The blood showed the presence of a high grade anemia.

Roentgen examinations revealed the fol-



Fig 8 Case 2 Irregular mottling or moth-eaten appearance of entire shaft of humerus, with pathological fracture of proximal end

suggestive of increased intracranial pressure. Sawtooth-like indentations of the outer table of the skull were noted. The bones of the extremities, at this time, showed nothing abnormal except cross-striations near the epiphyseal lines, indicative of previous growth disturbances. The abdomen, examined because of a suspected adrenal tumor, showed no pathology.

The chest presented a large well circumscribed tumor mass, replacing the apex of the right lung and extending to the level of the sixth rib posteriorly, with no demonstrable evidence of erosion of the spine or ribs.

On August 2, films made with special reference to the orbits showed a blurring of outline of the left orbit which was interpreted as possibly being due to pressure erosion from the orbital tumor mass. Examination on Aug 10 of the head and of the chest showed no appreciable changes.

Films made of the femora on Oct 1, because of pain developing in the thighs, presented an elevation of the periosteum with new bone formation along their entire

length. Irregular decalcification of the lower end of both shafts was also present, and of the upper end of the left shaft. These findings were interpreted as being consistent with metastases. The possibility of a sclerosing periostitis of toxic origin was given consideration. The upper extremities also presented slight irregular decalcification and periosteal changes.

During the clinical course the proptosis of the left eye increased markedly, and the eye ball was enucleated for palliation on July 24. The tumor masses present on admission grew progressively larger, and another tumor mass developed in the left temporoparietal region. The cervical glands became more numerous, biopsy of one of them revealed a neurocytoma.

The temperature ranged from 99 to 104, the pulse from 120 to 150, and the respirations from 22 to 40. Anemia, cachexia, and weakness became progressively more pronounced, and death occurred Oct 31, 1933, five months following the onset of symptoms.

Administration of deep roentgen therapy, giving 550 r units over the tumor mass in the chest (July 28 and Aug 2), effected no definite changes in the size of the tumor or course of the disease.

The clinical diagnosis (confirmed by biopsy) was neurocytoma (sympathetic neuroblastoma), originating in the optic nerve and metastasizing to the chest, bones, and brain or meninges.

The autopsy findings (abstracted from report made by Dr George Milles) were as follows. The head presented a protruding tumor mass, measuring about 8×10 cm, in the region of the left orbit and extending into the frontal and parietal regions. The orbit was distorted and the bulb was absent. A swelling, measuring about 9×7 cm, was present over the vertex, and irregular matted nodules up to 5 cm in size were present in the cervical region.

Moderate congestion and edema of the lungs were present, and there were parenchymatous changes in the heart, kidneys, and liver. The adrenals, gastro-intestinal tract, spleen, and uterus gave no pertinent

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lowing On Oct 18, films made of the skull showed slight separation of the coronal suture, suggesting increased intracranial pressure The chest showed the presence of a circumscribed density overlying and replacing the apex of the left lung

On Oct 31, films of the long bones showed no demonstrable pathology, and the skull showed no progression of the findings noted on the previous examination

On Dec 14, films of the skull showed marked widening of all the sutures, and apparent enlargement of the entire skull Irregular mottled decalcification was present These findings were even more pronounced on films made Jan 15, 1935, and ray-like calcareous deposits were seen projecting from the outer table of the skull, with irregularity of bone contour in the frontal region, and an apparent bone defect at the vertex

Definite findings in the long bones were first demonstrated on films made on Dec 31 Irregular decalcification of the bone was present in the distal ends of the shafts of both femora The right humerus showed periosteal elevation along the distal portion of the shaft On Jan 16, 1935, the findings in the femora were more marked, especially on the right side The left humerus showed similar findings in the proximal end, and the right humerus showed a marked irregular mottling or a moth-eaten appearance along the entire shaft, with the presence of periosteal elevation A pathological fracture of the upper end of this bone was also present at this time

The findings in the chest remained approximately unchanged during this period

During the clinical course the metastases present on admission grew progressively larger and new nodules appeared Transfusions given for the anemia produced no effect, and death occurred on Jan 25, 1935, five months following the onset of the symptoms

Deep roentgen therapy consisting of 2,800 r units in fractional doses (200 r units daily) over the tumor mass in the chest, produced no demonstrable changes Adminis-

tration of 1,200 r units to the supra-orbital tumor also had no apparent effect

The clinical diagnosis was neurocytoma originating in the cervical sympathetic region, with diffuse metastases

Autopsy findings were essentially the same as in the first case, and confirmed the antemortem diagnosis

COMMENT

The cases presented exemplify the high degree of malignancy of sympathetic neuroblastoma as shown by the rapid progress with diffuse metastases, and serve to call attention to the difficulty encountered in attempting to localize the primary site of the lesion *antemortem* They are unique in that the roentgen examinations revealed the original tumor located in the lower cervical region, presenting itself in the chest and replacing the apex of the lung In addition, they showed marked metastatic bone changes which were fairly characteristic They demonstrate that a provisional diagnosis can be made on the basis of the presenting symptoms, usually those of the metastases, and consisting of supra-orbital swelling, proptosis of the eye, and roentgen findings

SUMMARY

Two cases of sympathetic neuroblastoma of cervical sympathetic origin are reported in detail, with special reference to the roentgen findings These consisted of a tumor mass in the chest, which represented the primary lesion in both cases, together with multiple metastatic lesions in the skull and long bones Roentgen therapy applied in both cases failed to affect the tumors appreciably, and produced no apparent change in the course of the disease

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Yes, and we have spread a barbed wire entanglement of "thou-shalt-nots" about the human nature of our neighbor in the fond belief that thereby we could curb his natural depravity, purify his morals, and convert his conscience to such an extent that he'd never get past the ban of our prohibitions until he should sprout wings and fly over—to that blessed country where the righteous cease from troubling and the wicked are at rest

And everywhere, throughout this broad American land of ours, we have taken the tide of speculation at its flood in the last few years and have gone on an economic joy-ride on a barge of promissory notes, and when the flood goes out and the barge comes down and the notes fall due, once more we will stretch forth the pontifical hand of legislation and, like Joshua of old, command time to stand still, bid the sun to pause in his career over Gibeon, and the moon to hang motionless above the vale of Ajalon, until we get ready to pay our debts

And then dear old Uncle Sam—God bless his benevolent old hide—arrays himself in his Santa Claus suit and goes jingling through the land, scattering sugar in every direction, and behind him comes the tax collector gathering where Santa has not scattered. That is where you and I come in—that is where we do our part and win our Blue Eagle, and when we get through doing our part we may be even bluer than the eagle for there is nothing that escapes the tax collector

We are supposed to be the tax collector's sugar bowl and no bowl is so small or so scantily supplied with sugar to be beneath the tax collector's notice or to escape his scoop. Not even a lawyer's purse! Or, to shift my metaphor, we are the black sheep of the flock and up and down the land rings the nursery refrain,

'Baal Baal Black sheep,
Have you any wool?'

and whether we have three bags full or just a little fuzz, it's coming off, and we will

be lucky if the hide doesn't go with the hair

Nothing is so flimsy or so skimpy as to escape the tax collector's shears—not even women's underwear. Yes, sir, the process tax has taken hold of women's underwear for the benefit of the Southern cotton farmer on the theory, I suppose, that when the women took off their petticoats they ruined the South. But I am sure you will agree with me that there is no kind of a tax so wholly un-American in principle as the tax on women's underwear. That is just a flagrant illustration of taxation without representation

But after all, we shouldn't get so worried about the idea of the tax burden. We have a method already under way that is going to relieve us of the oppressiveness of taxation. We are making our money so cheap that pretty soon it won't be good for anything except to pay taxes and debts

Then, I don't think we ought to get unduly worried about this big spending spree that the country is going on. All of the money that the Government has been putting out in the interest of economic recovery was borrowed money, which is the easiest money in the world to spend, once a fellow can get hold of it. And, you know, there is not anything in the world that so stimulates enterprise, that so stimulates business activity, nothing that so encourages far-sighted investments by short-sighted investors, as borrowed money

Just a few years back here in the golden age of the New Era, think what happened! Back there in 1928 and 1929 we saw little businesses start out, expand, become big businesses and spread out and become bigger businesses, spread out and become going concerns—and now they are gone!—all because of borrowed money

But I wouldn't have you get the idea for anything in the world from anything I have said that I am not a lover of my country. I am really one of its most ardent lovers. Of course, we have our little tiffs now and then, as any lovers will, especially when tax-paying time comes 'round, and

THE FUNNY BONES OF THE HUMAN HEAD, VIEWED IN THE LIGHT OF THE CO(S)MIC RAY¹

By HONORABLE HARVEY T HARRISON, *Little Rock, Arkansas*

AM indeed grateful to my friend and your distinguished fellow-member, Dr Rhinehart, for the complimentary introduction he gave me. Perhaps I'd be impressed by it more than I am except for the fact that on numerous occasions I have tried in vain to convince twelve good men and true that Dr Rhinehart is worthy of belief. But notwithstanding that fact, I still am ready to maintain that he is one of the finest expert witnesses that money can buy.

Notwithstanding the complimentary words which have been spoken concerning me by Dr Rhinehart—words which, had they been spoken of anyone else, would have sounded almost like flattery—I am going to assume a democratic attitude toward you this evening. I am going to talk to you and treat you just as if you were my equals. I want everybody to feel perfectly at ease in my presence this evening, even the ladies. Don't suffer yourselves to be embarrassed or in the least intimidated by this arrogant and supercilious air which I carry around with me. After all, this manner of mine is not a real presentation of my inner attitude. I can't help looking this way. You see, by nature, I have a proud and a haughty bearing. That is because I belong to the ruling class in this country. I am a debtor. Thanks to the New Deal, the ancient Scriptural maxim that the borrower is servant to the lender has been reversed, now it is just the other way 'round.

This happy topsy-turvydom is the outcome, I suspect, of the present-day mood for political experimenting—a mood which proceeds on the assumption that the old order changeth, yielding place to new, and God fulfills himself in many ways lest one good custom should corrupt the world.

There was once an old American custom that made it respectable for a fellow to pay his debts. We are now operating under a new American custom that regards it as old-fashioned for a fellow to pay his respects.

But there is one old custom which doesn't seem to change, one old custom which time cannot wither. That is the custom of trying to cure all our social and economic distempers by the enactment of laws—salvation by statute. Whenever our money gives out, our legislatures give in. When times are hard, legislation is easy.

Legislative panaceas change very little from age to age, that is, they change very little in substance. They always operate on the principle that when Fortune ceases to smile on the prodigal, legislation should frown on the frugal, that the best way to liquidate the liabilities of the improvident is to soak the prosperous, that economic recovery is best brought about by that method which substitutes for the system that every tub should stand on its own bottom a system whereby most of the tubs stand on a few bottoms.

So in our American system, whenever we are in economic doubt or in doubt about any other of our problems, our method is to sit down and write to our Congressman. Whether our troubles be sociological, biological, or economic, every son of affliction among us rises up to declare that there ought to be a law, both here in the great State of Tennessee, where you have enjoyed such fine hospitality from a very pure strain of the sons of men, and over in my own State of Arkansas, where we lifted the frowning barrier of a municipal statute across the path of natural law in the belief that by so doing we'd stop the trend of evolution dead in its tracks.

¹ Humorous speech delivered at the banquet of the Radiological Society of North America at Memphis Tenn. Dec 6 1934

It would be pressing the stroke, perhaps, to say that by this time America had come of age, but it is no exaggeration to say that it had arrived at the age of indiscretion.

But coincident with the birth of our new freedom there developed a very irritating and an exceedingly ironical complication. We had no sooner gotten rid of our moral restraints, no sooner had we been divested of our inhibitions and had donned our moral negligee, than we discovered that our liquor had been taken away from us. Of course, that was a very exasperating experience. Just think of it, the irony of that situation! Not an inhibition on the premises, a long-repressed libido that had at last broken jail and was yearning to celebrate, and not a drop to drink!

It was particularly provoking to a typical 100 per cent American of my years and disposition. There I was, without any war on my hands, facing the world with nothing but a pocketful of money made out of war profits—nothing but this money and a rambunctious libido that was looking for an opportunity to get going. As I say, this was a provoking situation in which to find myself, being as I was this type of a person—one who up to that time had been so circumspect in all of his conduct (I mean his public conduct), so regardful of all the proprieties, that to have known me then and to have listened in on my conversation up to that time you would have been justified in suspecting that I was descended from a long line of maiden aunts.

But when they took away my moral restraints and when my liberated libido smote on its chest with a brawny fist and leaped to the driver's seat of my behavior and shouted, "Boy, let's go!" and went speeding to the cupboard for the jug of rum, only to find that the cupboard was bare, I realized then that I was the victim of a very unkind sort of joke.

And so what happened is what you would naturally expect to happen, being what I was—a 100 per cent American. I was at that time made up of one part Puritan, one part reformer, and one part rebel, and

when these three parts set up in a fellow's disposition and begin to take notice of one another's presence, you can always look out for a ruction.

But this is not all of the indignities that were heaped on us, for while our attention was distracted by the many things that Volsteadism had heaped upon us and all of the problems that it had thrust up, while all of us pious folks were busy shaking our fists under one another's noses and sputtering and cussing each other in dispute over moral questions, the ultimate indignity was foisted upon us—woman suffrage.

Then we realized that this glorious democracy of ours was going to have to put up with just twice as much of the same thing. Of course, petticoat government was not a new thing in American experience, but up to that time it had been purely a domestic and a private régime. I might say this in our defense—that while we had stoutly for generations held out against the aspirations of mother, wife, and sweetheart to share with us the responsibilities and the prerogatives of the ballot, our opposition had not been due to any lack of affection for our women-folk or any lack of confidence in them. Our opposition was, rather, inspired by fear—the fear that since politics makes strange bedfellows, the converse might be true.

This survey of American history brings us up to that point in our experience where the War-to-end-wars had been tidily tucked away for all time in the closed files of history, and where we had gotten rid of our inhibitions and our taboos, and where the veil of secrecy between the sexes had disappeared so that we were all ready to agree that a woman is just as good as a man. And it brings us up to the time when our behavior was perfectly circumscribed and safely insured against moral transgression by high walls of prohibitory statutes. So we were all ready, all set, to enter upon that new era, that era when poverty was to be abolished—that marvelous golden age that was ushered in under the auspices of the great construction engineer whose adversaries claimed that within four years

when somebody insists on applying the NRA code to my business, which I think is such a fine thing for my competitor's business

When I was much younger than I am now, I was exceedingly fond of my country, you might say almost overfond of it. I was so outspoken in my admiration of my country and took on over it so much in public that it is a wonder we didn't get ourselves talked about. At that time it seemed to me to be the very last word in perfection, being, as it was, "the home of the brave and the land of the free," where every citizen was a sovereign, free to worship God as he pleased and bent on making everybody else do the same thing.

But in the course of time the War came on. While I still was a great lover of my country, I saw no reason for acting foolishly and losing my head over it, so I addressed myself to the task of keeping the home fires burning. I can say without any thought of boasting and without any fear of successful contradiction that I maintained one of the hottest home fires that was to be found in my section.

I can remember when the hearts of the citizens of this great republic were quaking in terror at the very suggestion that at almost any time vast argosies of bombing planes were likely to appear above the fair cities of New York, Chicago, and Little Rock, those great centers of our country's population, and discharge those terrible explosives that were popularly supposed to blow a square mile of territory into smithereens in one blow and to scatter typhoid germs from coast to coast.

At that crucial hour I joined up with one of the most terrifying combat units this country has ever known—an organization of gas troops known as the Four Minute Men. Many a night when the call of duty came have I kissed my wife and babe good-bye, snatched up my deadly manuscript, and rushed down to a moving picture show or vaudeville theater, there to be sandwiched in between the lady acrobat and the trained seal, and for four inexorable minutes have held a vast audience at bay while

I stiffened my country's *morale* and inspired my countrymen to buy Liberty Bonds until it hurt. Now I have lived to see them hurt!

No man ever served his country in such hazardous labors as this more zealously than I did, no man ever uttered such hard and such mendacious words against his country's foemen as I directed against the Hun. I make this statement not for the purpose of bragging, but I do insist that if a fellow has a war record, he has a right to derive whatever prestige he can from it, and if a fellow has once offered to die for his country, why, he should expect to live off of it the balance of his life.

But I had no sooner got the War off my hands and the taste of calumny off my tongue and the stage all set to make the world safe for democrats, than I awoke to the discovery that a new state of mind had grown up in my country amid the distractions of war—that the clock of moral progress had struck *sex* in America. Well, sirs, that was a liberating discovery and it was attended with some very interesting developments.

The most immediate effect, of course, was to lift polite conversation out of the dull, humdrum levels of respectability and to set it moving in a fresh and adventurous direction—especially fresh. The vocabulary of social commerce took on a strong, gamy, bawdy, Elizabethan flavor, derived from an infusion of new words that up to that time had been shut up in the sly lexicon of unmentionables. For when men and women awoke to the fact that they could talk freely to one another about anything, they wouldn't talk about anything else.

Then all at once new areas of my country's anatomy began to show up, lovely and tempting areas, the existence of which, though long suspected, had never before been publicly acknowledged. Then was there fulfilled before my very eyes the prophecy which the Lord spake in the long ago to his prophet Joel, saying, "In those days your young men shall see visions and your old men shall dream dreams."

cial structure is a structure or an edifice where a group of strong-jawed, quick-deciding, slow-thinking men get together and swap promissory notes with one another and against this security issue all of these beautiful, iridescent *securities*. They call it "floating them," which is a good term for it because, like Ivory soap, they float on water. They made the most iridescent bubbles in the world.

So we saw this great country of ours filled with little grown-up children running about over the lea holding up pink, chubby fingers, reaching after the bright, beautiful iridescent bubbles that had been blown up out of the waters of these securities.

Just five years ago the bubble broke and down came lollypop, sucker, and all. Yes, just five years ago the people of this country woke up one morning to find that they could go out and buy what they wanted for just about one-half or two-thirds of what it would have cost them to buy it the day before, with this exception they couldn't charge it.

Well, this discovery scared us all nearly to death because for years the typical American had been taking to his heart as a special injunction to himself the last words of Marmion, "Charge, Chester, charge!"

When we discovered that we could no longer obey this beautiful injunction and when we discovered, moreover, that a dollar in the hand was worth two in the bank, it was more than our gumption could cope with. The shock was too great for us. Not knowing what else to do, we fell into a panic and began running around in circles like stampeded cattle and bawling to one another that the country was going to the bow-wows. And, because faith is a creative thing and because people tend to make their beliefs come true whether in the region of hope or in the region of fear, it wasn't long until every mother's son of us began to hear the wolf howling on his doorstep.

When the folks found that they couldn't any longer go out and borrow the money to pay off their debts, then they lost the r

nerve, the principle on which they had been living. The biggest bunch of optimists the world has ever seen turned pessimists overnight and began running to cover, scuttling to cover like so many crawfish whose response to a challenge is always a retreat.

The trouble about covering is this: that when everybody in the bed takes the same notion at once, the cover comes in for a whole lot of pulling. And since the currency blanket is not charity, which according to the Scriptures "covereth a multitude of sins," but, on the contrary, is short and narrow, the blanket gets torn in the tussle and everybody wakes up with frozen assets.

So it is no wonder that when the old credit cow began to go dry and her tits began to shrink up and to wither and to draw away from the lips of the multitudinous suckers who had been thriving on them, there should have arisen this clamor which to-day is filling the heavens—a clamor for a political technic that will shift the mazuma from the upper classes to the classes who are on their uppers.

This is an old cry. It is as old as human history, for the human story is nothing more than just one long fortune-shifting tug-of-war between the fellows who are down and out and the fellows who are sitting pretty. The old adage that "Uneasy lies the head that wears a crown" might very well be amended to say, "Uneasy rests the seat that is sitting pretty."

But should we get pessimistic or in terror over this? No. Pessimism would do little good, anyway. But let us not despair of the democratic adventure. Never despair of the democratic adventure when it is passing through its periods of fermentation. "Look not thou upon the wine when it is red, when it giveth his color in the cup, when it moveth itself aright." That is not the time to test its quality nor to appraise its vintage. That is the time when it is likely to abound in headaches.

So let us remember always for our encouragement in times like these that the fermenting juices of this new wine of present-day democracy are derived from

he ditched, drained, and dammed the country

But before surveying that bit of our country's history, I feel I ought to digress to tell you how we people, here in Tennessee and Arkansas, peculiarly prepared ourselves to be worthy of the great riches with which we were going to be invested. Riches bring on responsibility, of course. So in order that we might be pure and a superior race, particularly the people of my State, the State of Arkansas, followed the example that had been previously set by our proud neighbor here, the State of Tennessee.

Back in the general election of 1928 when Alfred Smith was running for President as a nominee on the Democratic ticket, two burning issues confronted the citizens of my State. We were called upon to decide at the polls whether the citizens of Arkansas had descended from monkeys, another question we had to decide was whether we were going to turn into Republicans. And what if we had done so? Wouldn't we feel now that subsequent events had sure enough made monkeys out of us?

But, you know, that is one of the troubles of evolution. You can never tell what it is going to lead to.

Well, both the Republicans and the monkeys were defeated at that election but by such a narrow margin that it left no room to the victors for bragging. However, I am not so much concerned with the political aspects of that great contest. What I want to remind you of is this: Just a little over six years ago I and the other citizens of my great State were in the grip of pitiless biological processes, just as many of you north of the Mason-Dixon line may be to-night. We didn't know what we might become, we only knew what we might be come from.

All that is changed now. We have ordained by popular vote of the people that no one shall teach in a tax-supported school in the State of Arkansas any theory that man is either ascended or descended from a lower order of animals. I hope you will

just notice what a beautiful statute that is, how noble in all its parts, how even-handed in its operation. There's nothing discriminating about it at all. It extends to every person within its sway the equal protection of the law, whatever his race, color, or previous condition of servitude.

And there is nothing snobbish about it, either. We haven't stopped at saying that man has not descended from a lower order of animals but we insist that our citizens haven't ascended, either. All we ask is just the privilege of holding our own!

We may not have realized the dream of the Brain Trust and have pegged commodity values at their 1926 level, but over in Arkansas we pegged human nature at its 1928 level. We have joined up with the great State of Tennessee here in the creation of a sort of refuge or preserve where the sons of Adam can continue to propagate their species without any fear of being crossed up by a simian taint.

Then came the dawn of a new era when we were going to abolish poverty and everybody was going to get rich, not in the cumbersome, old-fashioned way of our fathers, through the processes of thrift and industry, but going to get rich quick, when everybody turned sucker and began to lay hold of the lollypop of speculation. Everybody was running around and getting hold of debentures and securities, gold label (or rather gold libel) bonds and all manner of non-par, non-voting, non-paying, nonsense stocks—these things they called *securities* (or rather *mis-called securities*).

That was a part of the jargon that Big Business brought into existence at that time. Big Business brought us a new language—big words. Big Business no longer went to see a fellow to talk with him, Big Business "contacted" a man. That is a Big Business term for "touching" him. You no longer sold a fellow a bill of merchandise, you "serviced a customer," which is to say to clean him, and grease him, and put him on the skids.

Big Business prospered through the operation of financial structures. A finan-

CASE REPORTS AND NEW DEVICES

FAMILIAL BONY DYSTROPHY WITH MULTIPLE EXOSTOSES¹

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We have had the opportunity of making clinical and laboratory studies of members of a Lebanese family, a number of whom show defective bone development, associated with exostoses. The distribution of these changes in two generations as regards sex, as well as the character of the deformity shown in the roentgenograms, added unusual features to this study, and seemed to us of sufficient general interest to warrant reporting.

F (Case No 15,978), a baker by occupation, whose photograph is shown in Figure 1, came to us on June 3, 1932, complaining of bony prominences in different parts of his body, which he had had since childhood. We give a summary of the history and examinations of that date.

His past history showed no other illnesses except chicken-pox at the age of seven, and malaria at the age of twelve.

His present history revealed that when he was from three to four years of age, his parents noticed hard bony prominences on the lower parts of his legs. These were painless, not being accompanied by any sign of inflammation, and not preceded by trauma. About two years later, similar growths appeared around the knees and the upper extremities. The latter were accompanied by a slow bowing of the forearms, with concavity toward the ulnar side. He feels quite well, and has no difficulty in locomotion.

The patient is a healthy looking young man of good muscular development, weighing 51.5 kilograms, 159 cm in height. His head and trunk are not deformed, but his arms and legs show shortening.

The patient's head and neck are negative except for a hard bony prominence about the size of an almond over the lower part of the occipital bone. His teeth are normal. There is no evidence of disease of the thoracic or abdominal viscera.

Extremities hard masses can be palpated and in several sites are accompanied by visible

swellings, corresponding to the exostoses shown in the roentgenograms. The forearms are shortened and bowed, with concavity toward

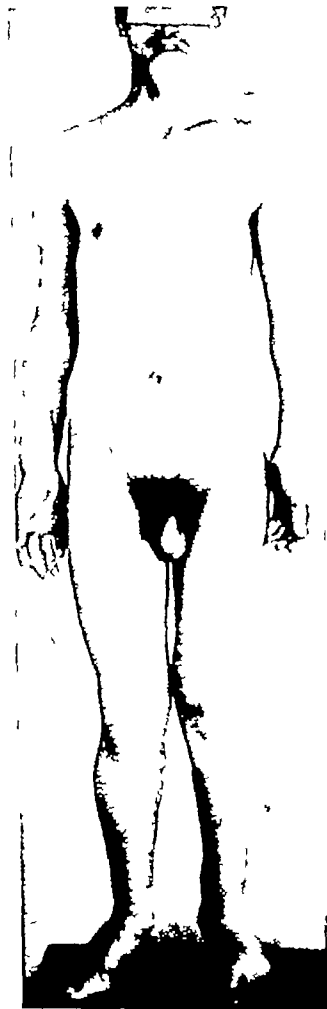


Fig 1

the ulnar side. The legs are also shortened. The big toe on the right is prolonged, the second is very short, and the curvature of the plantar arch is increased. The reflexes are normal. There is no muscular atrophy, no sensory disturbances. The external genitalia are normally developed.

The laboratory findings are as follows: blood count and urine examination are negative. The stools show ova of *Taenia saginata*. The blood chemistry showed plasma phos-

¹ Accepted for publication Jan 5, 1935

grapes grown in the very same vineyards, the good old wine which our fathers bought
garnered with the same hopes and aspira- with their treasure and their blood and
tions, trod in the very same presses, and which is stored in the cellars of our political
processed through the same chemistry as faith



Fig 4

The basal metabolism was definitely increased on two occasions, being $+27.5$ and $+32$. These figures have added significance as, according to work done by Turner and Aboulshadid, the basal metabolic rate of Syrians is normally about -10 .²¹ In spite of this laboratory evidence, there were no clinical findings of hyperthyroidism.

We have also gone in some detail into the genealogy, and have examined other members of the family. Table II sets forth these data in detail.

The patient's mother shows the same type of exostoses involving her extremities, with similar deformity of her toes. She had married twice, our patient being a son by the first marriage. He had a sister aged 18, who was also affected. By the second marriage there were six living children, ages ranging from 17 days to 12 years. In one of these, a girl of 9, the presence of the typical exostoses was demonstrated by roentgenography. There was no history of bony deformity in the mother's parents, brothers, or sisters. Blood calcium, phosphorus, and chole-

sterol estimations made in several members of the family were all within normal limits. In all other respects the members of this family were in good physical and mental health.

COMMENT

Although we feel the members of this family should be followed carefully in the coming years to detect those who may later develop bony deformities, we have presented a record of these cases to date.

There is no history of syphilis in the family and the Wassermann reactions are all negative. The bony changes do not suggest an inflammatory or neoplastic origin. We have here an hereditary disease which is transmitted by the mother to her children, born of two marriages. Although we cannot ascribe these anomalies of growth to any definitely known endocrine disease, we consider a familial dysplasticism as the most probable cause.

Scarsdale, N. Y.

A SIMPLE METHOD OF MAKING SERIAL FILMS WITH THE POTTER-BUCKY DIAPHRAGM

By W. O. WEISKOTTEN, M.D., *San Diego, California*

For years it has been our custom to make serial films of certain portions of the gastrointestinal tract for the purpose of proving or ruling out suspected pathology demonstrated with the fluoroscope. Prior to the time the Potter-Bucky diaphragm came into use, some sort of a more or less complicated and expensive apparatus was necessary in order to properly localize the part under observation, and to provide a means of holding and shifting the cassette used in making these serial films.

All of the various types of apparatus sold by manufacturers were designed primarily to be used without the Potter-Bucky diaphragm. Some may be used with a flat Potter-Bucky diaphragm but none of them can be conveniently used with a standard curved top diaphragm. Most roentgenologists are now making their gastro-intestinal films with a fast Potter-Bucky diaphragm, with a fraction of a second exposure, thereby obtaining better films, especially if the patient weighs 150 pounds or more.

The making of single films of the gastrointestinal tract with the Potter-Bucky diaphragm is of course a simple procedure, but often there is indication for the making of a series of films of the pylorus and duodenum, either curvature of the stomach, the cardiac portion of the stomach, or of certain portions of the small or large intestine when the pa-

²¹ I. TURNER and I. ABOULSHADID: The Basal Metabolism and Vital Capacity of Syrian Women. *Am Jour Physiol* February 1930 92, 159.



Fig 2

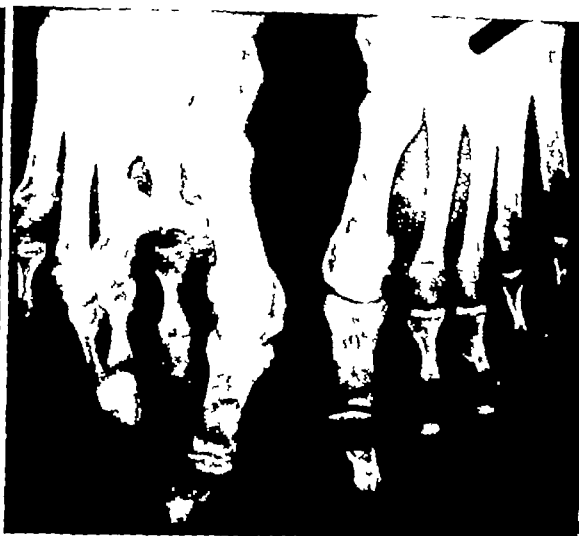
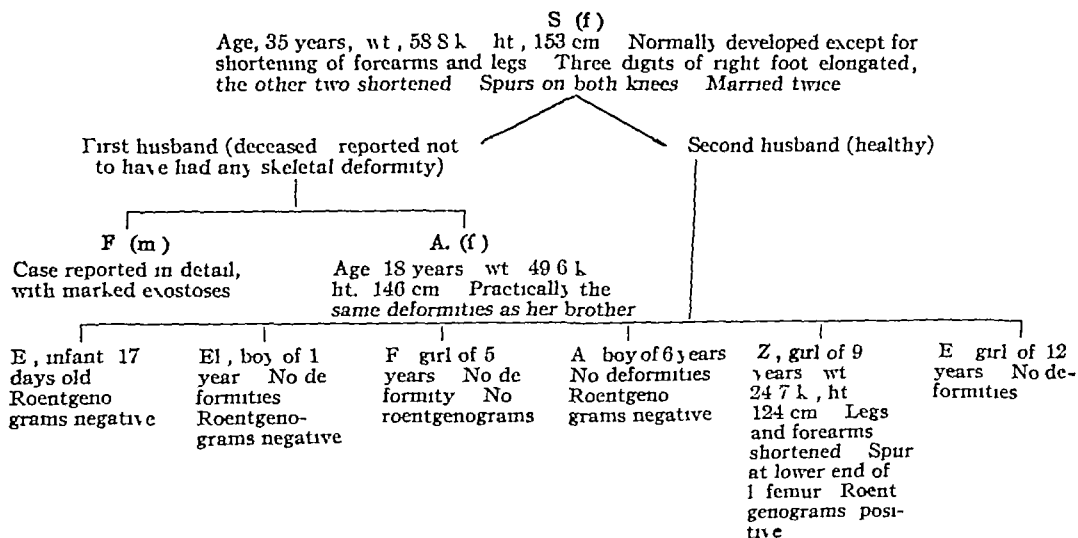


Fig 3

phates, 4.99 mgm per 100 c c, chlorides, 596 mgm per 100 c c, blood uric acid, 2.5 mgm per 100 mgm per 100 c c, serum calcium, 9.97 mgm c c

TABLE I—BLOOD SUGAR AND PHOSPHORUS CURVE

Fasting specimen	Sugar 72 mgm per 100 c c	Inorganic phosphorus 3.53 mgm per 100 c.c
1/2 hr after 50 gm of glucose	114 " " " "	3.41 " " " "
1 hr	87 " " " "	3.46 " " " "
2 hr	72 " " " "	3.15 " " " "

TABLE II—FAMILY GENEALOGY¹

¹ Members showing bony deformity are printed in heavy type
parents brothers or sisters of S mother of our patient

There was no history of deformity in par-

tube and the center of the upper right quarter of the cassette The tube is now moved back

The usual fractional second exposure is made, the subsequent serial films are made by shift-



Fig 3 A typical serial film made with the Potter Bucky diaphragm

to its normal center position over the Bucky This prevents grid lines, and utilizes all of the available radiation

ing the cassette and the lead shield in a manner which will expose each quarter of the film, and protect the remaining quarters

EPITHELIALIZATION OF CHRONIC OSTEOMYELITIC CAVITIES

A PRF-CANCEROUS LESION

By ALI NANDLER BRUNSCHWIG M.D., F.A.C.S.
Chicago

From the Department of Surgery and Division of Roentgenology, University of Chicago Clinics

In a previous report, three cases of chronic pyogenic osteomyelitis, with draining sinuses of over 50 years duration, were de-

scribed, in which the large intramedullary cavities were found to be partially or nearly completely lined by stratified squamous epithelium (1) This was the result of a down-growth of the cutaneous epithelium along the draining sinuses An additional case was reported by Milgram (2) Erdheim (3) showed that in an analogous manner epithelialization of small tuberculous cavities in the calvarium may take place

The following case is recorded because it is another instance of epithelialization of a chronic osteomyelitic cavity, in the manner described

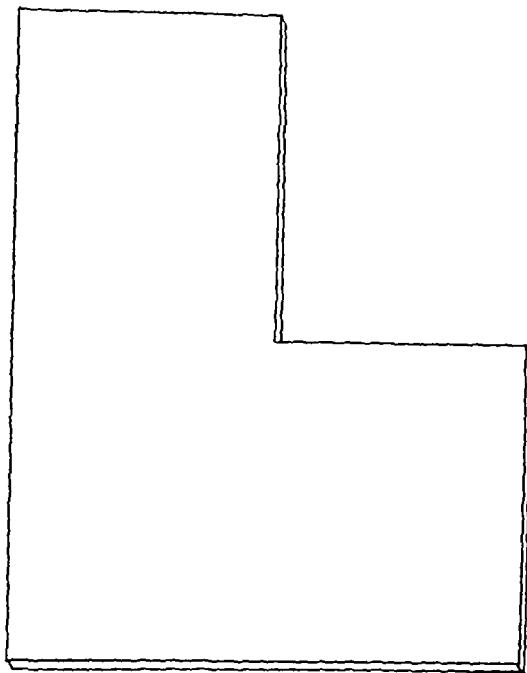


Fig 1 A diagram representing lead shield reinforced with sheet brass—total thickness three millimeters, made to fit a 11×14 cassette, one quarter cut away for serial exposures

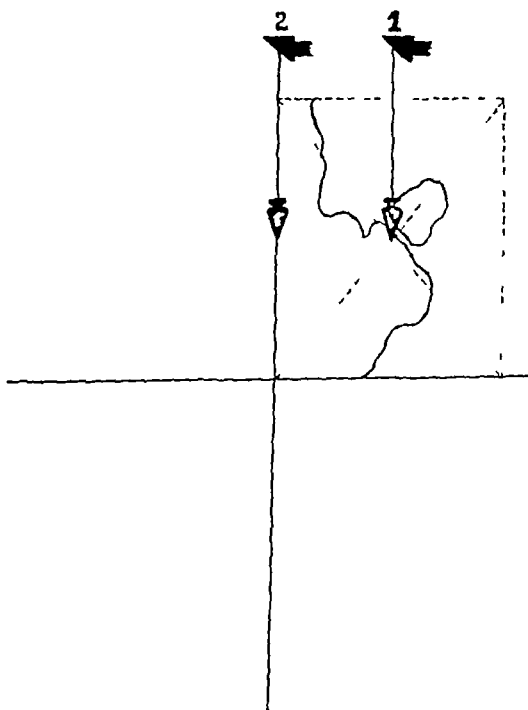


Fig 2 Shows a permanent mark on the top of the Potter-Bucky localizing the center of the unprotected portion of the film. Tube position "1" is for localization of the patient, tube position "2" for exposure

tient's weight really demands the use of the Potter-Bucky diaphragm

For some time the writer has used, with a great deal of satisfaction, the lead cassette shield here described, and a standard curved top Potter-Bucky diaphragm for making serial films of the gastro intestinal tract. A flat-top Bucky would work equally well or possibly better if the top of the diaphragm does not sag under the patient's weight. The method is very simple and the cassette shield is inexpensive, the older method of making films without the Bucky has been entirely discarded.

A piece of sheet lead, the exact size of the cassette to be used, is accurately cut, and the edges smoothed and squared. One quarter of this lead shield is carefully cut away, and a thin piece of tempered brass is made to accurately fit the lead shield. Instead of fastening the brass sheet and the lead together with small rivets, the edges are "sweated" or soldered together, and later smoothed with a file and emery cloth. This makes a neat-looking shield, free from rivet holes. The brass sheet backing protects the soft lead from bending and renders the whole shield more substantial. The shield with lead and brass is approximately three millimeters thick, and care must be exercised in handling it in order to prevent bending. It must lie absolutely flat on the top of the cassette, if not, the moving grid may interfere with it. If a Victor Bucky diaphragm is used, additional space between the cassette and the grid may be obtained by reversing the cassette tray, one side of the tray is higher than the other. This method may be applied to any Potter-Bucky diaphragm. If there is not sufficient clearance between the top of the cassette and the moving grid, it is a simple matter to construct a tray which will allow an additional three millimeters of space.

With the cassette in the center of the Bucky tray, the lead shield is so placed as to leave the upper right quarter of the film unprotected. A point is permanently marked on the top of the Potter-Bucky diaphragm corresponding to the exact center of the unprotected quarter of the cassette. The tube is now moved laterally, and, by means of a plumb bob, is centered to the permanent mark on the top of the Bucky. A file mark is placed on the horizontal arm of the tube stand which marks the proper location of the tube off center for future use.

The patient is examined in the prone position with the fluoroscope, and that portion of the gastro-intestinal tract under suspicion is marked with a square of adhesive plaster affixed to the skin of the back. The patient is now placed prone on the Potter-Bucky diaphragm, and the square of adhesive plaster is brought in a vertical line with the center of the

mous-cell carcinoma Sections of the fragments curetted from the deepest portions of the cavity show stratified squamous epithelium proliferating over sclerotic cancellous bone

Pathologic Diagnosis—Partial epithelialization of a subcutaneous sinus draining an osteomyelitic process Partial epithelialization of chronic osteomyelitic cavity in the tibia



Fig 2 Photomicrograph ($\times 60$) of section from wall of sinus, draining osteomyelitic cavity in tibia The sinus is lined by stratified squamous epithelium (A) granulation tissue presumably from non-epithelialized areas is present over a portion of the epithelial lining (B) Elongated cords of epithelial cells (C) extend from the lining into the subjacent dense fibrous tissue in places suggesting early malignant degeneration

Fig 3 Photomicrograph ($\times 63$) of section through curettings from deep wall of intramedullary cavity in tibia Segments of stratified squamous epithelium (A) alternating with spicules of bone (B), indicate that partial epithelialization of the cavity has occurred, by down growth of cutaneous epithelium along the draining sinus

Some bony fragments exhibit no epithelial covering No calcified marrow is seen (see previous reports)

DISCUSSION

Epithelialization of chronic osteomyelitic cavities, by down-growth of the cutaneous



Fig 1 Chronic osteomyelitis with cavity formation in the shaft of the tibia at the site of previously ununited fracture. A chronic sinus draining this cavity was present on the anterior aspect of the leg

above. Whereas in the other four reported cases the osteomyelitis was present for 50 years or more, in this instance it was of 17 years' duration.

CASE REPORT

P. H. (116,021), white male, aged 65 years, was admitted to the University of Chicago Clinics on Nov. 5, 1934, presenting an oval epithelioma about 2 cm in diameter on the inner aspect of the left cheek just within the angle of the mouth. This lesion was a recurrence after operative removal 12 years previously.

In 1914, as a result of a fall, the patient sustained a fracture of the mid-portion of the left tibia. Following immobilization, there was non-union, and a bone graft was applied unsuccessfully. The non-union persisted until 1918, when a second operation was performed,

at which time the fragments were wired. Following this procedure there was pain and swelling in the leg and high fever, necessitating removal of the wires. The acute symptoms then subsided, but a draining sinus persisted. In 1923, a second bone graft (from the right tibia) was applied, and this was followed by consolidation, and closure of the sinus. There were no symptoms until 1931, when the sinus re-opened spontaneously and the surrounding tissues became swollen and quite tender. This sinus has persisted, but the patient is able to use the extremity with the minimum of discomfort.

The significant findings on physical examination were: (1) the intra-oral lesion described above, the malignant nature of which was confirmed by biopsy, (2) an oval area about 8×4 cm on the anterior aspect of the mid-portion of the left leg, in which the skin is thickened, scaling, and exhibits a dark blue discoloration. In the center of this area was an oval sinus about 1 cm in diameter and 1.5 cm deep, leading to the bone. A small fragment of the sinus wall nearest the bone was removed for microscopic examination. Sections show the presence of stratified squamous epithelium.

Roentgenograms of the left tibia showed, at the junction of the upper two-thirds of the shaft with the lower third, an old sclerotic osteomyelitic process several centimeters in length, in the central portion of which was a transverse oval cavity about 2×3 centimeters. In the upper portion of the fibula is an old united fracture. The fibular shaft below the fracture is hypertrophied.

Because the patient was suffering the minimum of discomfort from the chronic osteomyelitis, he permitted only a conservative procedure. On Jan. 10, 1935 (operation by Dr. Edmund Andrews), under ether anesthesia, a longitudinal incision was made in each direction from the sinus. Subcutaneous tissue was reflected off the bone with difficulty. The roof of the cavity was chiseled away, exposing its deep wall, which grossly was lined by a grayish membrane. The latter was curetted away as thoroughly as possible and the cavity saucerized. The extremities of the incision were closed by interrupted sutures, and the mid-portion was packed with gauze. A more extensive procedure would have predisposed to refracture at the old site. The intra-oral lesion was later treated by application of radium.

Microscopic examination of the walls of the sinus reveals it to be lined in part by stratified squamous epithelium, which in places extends as thin cords into the underlying dense fibrous tissue. At one point the proliferation is such as to strongly suggest an early squa-

teen days, we take stock. If the neoplasm is responding and has reached 50 per cent of its original size, the external radiation is continued. If it has not yet reached that size, all external radiation is terminated then and there in order not to modify the tumor bed too much, and in order not to have the tumor itself rendered more radioresistant by increasing the desmoplasia.

We give our interstitial radiation immediately, though the patient may be suffering with a very acute reaction—his skin peeled off, the mucosa of his entire oropharynx and aural cavity inflamed. At this time only a small amount of additional interstitial radiation is required to supplement the external radiation.

If we wait a longer time, the effect of the external irradiation will have worn off. Nature repaired its damage with fibrosis, and we must consider the residual lesion an entirely new tumor to be treated.

Another principle that we have found concerns the amount of filtration to be used with the x-rays. We have tried giving the x-rays with 2 millimeters of copper filter and have also treated a series of cases using 0.5 millimeter of copper filter. In both cases we have administered radiation at the same rate, *i.e.*, 200 r to one area in the morning and 200 r to the other area in the afternoon. The patients are treated every day except Sunday. When 0.5 millimeter of copper was employed, we noticed, at the end of two weeks, at which time a little more than half the dose had been given, that the reactions came on and were very acute, so much so that we usually terminated the external radiation shortly thereafter, when only about 2,400 r to each portal had been given.

One would assume that, coincidental to this acute destruction of the skin and mucosa,

there would be an equivalent effect upon the tumor, however, that is not the case, because the tumor is not modified as much as when a larger total dose is given. When a 2-millimeter copper filter is used, the full total dose of from 4,000 to 4,200 r units can be given to each of the two portals, making a total of from 8,000 to 8,400 r units.

Consequently, we advocate the use of a 2-millimeter copper filter in protracted external irradiation whenever possible. If some concession must be made to economic necessity, we suggest the curtailment of the distance factor, using only 50 or 40 cm distance, together with an increase in the milliamperage. Coutard always employs a 2-millimeter copper filter. He is not compelled to make economic concessions.

The final problem studied was the daily time factor, best studied through the medium of the radium pack. A 5-gram pack was used, as mentioned above. The patient was treated for one hour each day, giving 5,000 milligram-hours to one side of the neck on one day, and 5,000 to the other side on the succeeding day, averaging 2,500 milligram-hours a day to each portal. Then we set up two small 100-milligram packs, one strapped to each side of the neck, leaving them in place continuously so that irradiation was emitted for twenty-four hours a day.

In summarizing the results, we find that it requires only four-fifths of the amount of radiation with the small pack as was required with the large pack, given over the same period of time and producing the same results. In other words, 43,000 milligram-hours delivered to one portal with a small pack will produce the same degree of epithelitis and epidermitis, coming on at the same time, as is produced by 55,000 milligram-hours with a large pack.

epithelium along the draining sinuses, is not only of pathologic interest, but is also of clinical importance in that it appears to be a pre-cancerous lesion, as well as a cause for persistent drainage. For in a study of specimens exhibiting squamous-cell carcinomas arising in conjunction with chronic osteomyelitic sinuses draining cavities within the bone, it is noted that the carcinomas arise *within* the sinus or the bone cavities and extend outward. It would seem that the stimulus to malignant degeneration of the epithelial cells in these localities is twofold: first, their continued proliferative activity in attempting to completely line the sinuses and cavities, and, second, the constant irritation to which they are exposed as a result of the chronic inflammation in the surrounding tissues.

In the presence of osteomyelitic cavities, with draining sinuses of many years' duration, biopsies of the tissue deep within the cavities should be performed when possible. If stratified squamous epithelium is present, the likelihood of eradicating the process by local operation is remote. Most surgeons are now agreed that in elderly patients presenting extensive chronic osteomyelitis amputation is justified when symptoms are severe. In such cases in which epithelialization of the bone cavities is present, amputation will also remove a potentially malignant lesion.

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COMPARISON OF DIFFERENT TECHNIQUES IN PROTRACTED EXTERNAL IRRADIATION¹

B₃ MILTON FRIEDMAN, M.D. *New York City*

This exhibit represents a three-years' study of the principles and practice of protracted external irradiation in the treatment of mouth and throat neoplasms. As a result of this, we have been able to elaborate fundamental principles pertaining to that technic with some degree of certainty.

In the beginning, we attempted to reproduce Coutard's exact technic, administering 200 r units (with back-scattering) through two por-

tals, one treatment in the morning and one in the afternoon. The factors were 200 K V, 4 ma, 60 cm distance, 2 mm Cu and 1 mm Al filter, 10 × 15 cm portal. This produced an epithelitis that commenced on the thirteenth day, and terminated on the thirty-ninth day, and an epidermitis that commenced on the seventeenth day and terminated on the forty-fourth day. In other words, the two reactions overlapped. Both reactions reached a second degree intensity and were accompanied by superficial denudation of the skin.

After having standardized this technic, we used the 5-gram radium pack filtered through 6 mm of lead and administered it in such daily doses as to reproduce similar biological burns of the skin and mucosa. The portal measured 8 × 10 cm, and the radium-skin distance 6 centimeters.

This we have done in 125 cases over a period of about three years and as yet have found little or no superiority in the radium over the x-rays. This astonished us greatly, since it was *contrary to our former working hypothesis and contrary to the experience of most other workers*.

We are unable to explain the fact that this ray of very short wave length, greater penetrability, and presumably greater potential energy from the radium pack is not very superior to the x-rays.

We were able to establish another principle with reference to interstitial radiation. During the course of the administration of these daily treatments of divided doses, if the tumor has shrunk approximately 50 per cent at the end of from fourteen to sixteen days, it will probably disappear completely as a result of the external radiation alone. If the neoplasm has not yet shrunk 50 per cent in from fourteen to sixteen days, it will become necessary to institute interstitial radiation.

If this interstitial radiation is given after the reaction has subsided, which would be about six weeks after the first treatment, the fibrosis produced during the process of repair will have altered the character of the tumor, rendering it much more radioresistant. Also, as a result of the extensive external radiation, the tumor bed will not be able to tolerate the amount of interstitial radiation we would like to give. Consequently, if we find that our external radiation has failed in completely eradicating the tumor and we must give interstitial radiation, we have a much more difficult problem to handle, namely, a tumor which is more radioresistant and a tumor bed which cannot tolerate the amount of interstitial radiation necessary.

Therefore we have adopted this working hypothesis at the end of from fourteen to six-

¹ Presented before the Radiological Society of North America at Memphis, Tenn., Dec 3-7, 1934.

"Our problem is to bring adequate medical care within the reach of those who cannot at present afford it To this end the co-operation of the medical profession is vital, and I have every confidence that such co-operation will be accorded by the profession which has always had such fine traditions of public service "

In closing, I hope you will not think I have taken undue advantage of my opportunity to appear before a scientific body of this character and force upon you a topic of economics However, this issue is approaching Every one present is more or less involved Sick-ness insurance has been tried in many countries, in no country has it been suggested or promoted by those supposed to reap the benefits from its operation

In 1880, Bismarck, in Germany, introduced it for political purposes In 1911, Lloyd George, in England, proposed it purely for political purposes In no country has it improved the practice of medicine or the medical profession Make yourselves thoroughly familiar with the various phases of sickness insurance

I know it has always been distasteful to physicians to delve into these matters, but are you going to sit idly by and let the American Association for Social Security or one of a dozen other organizations pass legislation shackling your individual control of your own business? Do you prefer State-paid, high-salaried commissioners dictating to a low-salaried physician how he should render inadequate medical service (which it will be) to the lower income group who have not even asked for it?

Gentlemen, this problem is worthy of your most earnest consideration

W L WILLIAMSON, M D

ANNOUNCEMENT

PAN-AMERICAN MEDICAL AS-
SOCIATION S CRUISE FOR 1935

CHANGES IN PLANS

Please note important change in ship, time of sailing, and shortening of Pan-American Medical Association Cruise, made necessary by the fact that the steamship *Columbia*, which had been chartered, has been discontinued from cruise service The Officers of the Pan-American Medical Association have succeeded

in chartering the *Queen of Bermuda*, a most luxuriously equipped ship which has a private bath in every cabin This, of itself, is a much desired convenience which will be appreciated by every traveling member Another advantage, in the opinion of many of us, is that the sailing date has been advanced to June 29, from New York, on to Rio de Janeiro via the West Indies, returning August 1 Practically the same itinerary that was contemplated in the original cruise will be carried out

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Member Governor of Cruise

COMMUNICATION

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The winter meeting of the Minnesota Radiological Society was held in St Paul, Minn, on March 16, 1935 The following program was presented

- 1 Radiography of Sphenoid Sinuses through the Open Mouth
Edward Schons, M D, St Paul
- 2 Roentgenological Study of the Mastoid, with Operative Findings in 230 Cases
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EDITORIAL

LEON J. MENVILLE, M.D., *Editor*

HOWARD P. DOUB, M.D., *Associate Editor*

PROPOSED SICKNESS INSURANCE¹

The development of the science of radiology has been phenomenal. Less than forty years ago the x-ray was discovered. It is doubtful if there has ever been such progress in any branch of medicine through all of its history up to the present time as you men present at this meeting have developed in the past ten years.

It is most unusual for a science to develop so rapidly that a pioneer in its development may receive the plaudits of the world for his success while still active in his profession. Usually his value is not recognized until long after his days of usefulness are gone.

This progress has been made possible by you men of vision. There has never been a greater revolution of ideas and ideals than has been exemplified by your tenacious and everlasting spirit of resourcefulness.

You have created for yourselves an enviable position. Your usefulness is indispensable. The surgeons, internists, and those practicing other branches of medicine fully recognize and duly appreciate your invaluable consultations. We no longer send patients to you for x-ray films, we send them for your opinion. Your diagnostic skill is an aid to every branch of medicine. You have evolved from x-ray mechanics to radiologic consultants.

You are in constant contact with the other members of the medical profession on questions of diagnosis and treatment of many diseases. This contact gives you a great opportunity to broaden your field of usefulness. For this reason, if I may digress to the common interest of the whole medical profession of the United States, I would solicit your attention and support for our common good.

Your progress has shown how diligently you have striven along scientific lines. That ability to do prompts me to direct your attention to

matters for the good of all. I want you as missionaries among the profession.

To-day we are confronted with an extraordinary situation of the utmost importance to the health and welfare of the people of the United States and to the medical profession, namely, enforced sickness insurance. Philanthropists, social workers, economists, and various foundations are apparently endeavoring to exploit the medical profession and assume control. This question will probably be presented to Congress soon, also to the legislatures of many States. The bills are drawn and the movement already has acquired much momentum.

You can have some influence individually but the American Medical Association is the only organization qualified to speak and act for the varying interests and ideas of the profession as a whole. Its official family has been earnestly and strenuously at work for months on this problem.

The American Medical Association has an abundance of information available to you. They urge in the *Bulletin* that you acquaint yourselves with the situation and give them your support. They do not believe it possible to defeat this legislation but they hope for the best compromise possible. The most encouraging item I have seen for a reasonable law came from the meeting of the National Conference on Economic Security. To quote a paragraph from President Roosevelt's address at this meeting:

There is also the problem of economic loss due to sickness—a very serious matter for many families with and without incomes and therefore an unfair burden upon the medical profession. Whether we come to this form of insurance soon or later on, I am confident that we can devise a system which will enhance and not hinder the remarkable progress which has been made and is being made in the practice of the profession of medicine and surgery in the United States.

At this same meeting, Secretary of Labor Miss Perkins said

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis, Tenn. Dec. 3-7, 1934.

"Our problem is to bring adequate medical care within the reach of those who cannot at present afford it To this end the co operation of the medical profession is vital, and I have every confidence that such co operation will be accorded by the profession which has always had such fine traditions of public service "

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BOOK REVIEW

RADIOLOGIC EXPLORATION OF THE MUCOSA OF THE GASTRO-INTESTINAL TRACT By The Cole Collaborators LEWIS GREGORY COLE, ROBERT EARL POUND, WILLIAM GREGORY COLE, RUSSELL WRIGHT MORSE, COURTENAY INGLIS HEADLAND, and AMES WILLIAM NASLUND. A volume of 336 pages, 243 illustrations and 18 drawings. Published by Bruce Publishing Company, St Paul, Minn., 1934. Price \$7.50 (cloth) and \$10.00 (three-quarters morocco).

According to the authors, the object of this book is to describe and analyze the fundamental roentgenologic principles on which the diagnosis of various lesions of the gastro-intestinal tract must be based and to correlate the anatomic, pathologic, and roentgenologic findings. It is really an elaborate discussion of the Lewis Gregory Cole method of examination of the gastro intestinal tract and his ideas of its physiology and pathology.

The first chapter is devoted to an interesting historical review of the development of gastro-intestinal roentgenology, in which the virtues of serial roentgenography are extolled. It is significant that in 1910 the senior author attempted to demonstrate the gastric mucosa by a special technic and subsequently has correlated the information gained by this procedure in selected cases with that obtained by his routine serial method. A pertinent discussion of the advantages and dangers of pressure technic is given. The authors state "We have yet to find a case in which small films, made with varying degrees of pressure, have caused us to alter the diagnosis as based on serial films of full size made without pressure", that "pressure interferes, in many instances, with the manner in which a normal or pathologic cap behaves and thus external pressure employed to exaggerate the mucosal pattern becomes a two-edged sword with which, we fear, many will cut their fingers."

In Chapter II the essential anatomic facts concerning the various parts of the gastro-intestinal tract are described in a very complete manner.

In Chapter III are recorded the findings observed roentgenologically in the various regions of the gastro-intestinal tract. According to the authors, the four fundamental findings which form the criteria for exploring the mucosa of the gastro-intestinal tract consist of (1) The lumen of the tract viewed in profile,

(2) special folds of the mucosa viewed on edge, (3) pliability of the mucosa to peristaltic contraction, and (4) the pattern of the mucosal folds or rugæ. The first three are described in detail in this chapter.

Chapter IV is devoted to a very comprehensive and excellent consideration of the fourth fundamental finding, *i.e.*, the pattern of the mucosal folds or rugæ. It is of particular value because of the present interest in this subject.

In Chapter V the authors have correlated and evaluated the four fundamental findings previously considered. The various technical methods are discussed and criticized and the advantages of serial roentgenography emphasized. The authors' satirical derision of fluoroscopy adds a certain amount of punch to this chapter that older roentgenologists may enjoy. Certainly if one were to take this discussion seriously the fluoroscope would join the ranks of the "forgotten man." The summary of the relative value of the fundamental findings is worthy of repetition. "The first finding, alteration in contour, is the foundation on which roentgenologic diagnosis of gastro intestinal lesions are based. The second finding, mucous membraneous folds, is applicable only in local regions for the diagnosis of small lesions. The third finding, pliability of peristalsis, is a very delicate test. It is applicable only when serial films are made, but it indicates the smallest in duration that can be diagnosed, smaller even than can be seen or felt by the surgeon at operation. The fourth finding, mucosal pattern, is now in vogue and some observers are giving so much attention to it that the old reliable first finding is either disregarded or dressed up to look like the fourth."

The last part of the book is concerned with a verbal dissection of and comments on Forssell's article concerning the autoplasmic of the gastro intestinal mucous membrane, concerning which the authors' deductions are almost diametrically opposed to those of Forssell.

The appearance of the book is most timely because of the present interest in "pressure technic" and mucosal relief studies of the gastro-intestinal tract. The material is well arranged and much valuable information is presented. The historical data will interest the experienced roentgenologist and novice, for there is no doubt that the senior author has received insufficient recognition for some of the observations he pioneered, particularly those concerning the duodenal cap.

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 G E BURCH, JR., M D, of New Orleans
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 E A POHLE, M D, Ph D of Madison, Wisconsin
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THE APPENDIX

The Roentgenologic Diagnosis of Chronic Appendicitis A Bejul and L Holst Fortschr a d. Geb der Röntgenstr 1934, 50, 344-349

The following conclusions are drawn

(1) Every normal vermiform appendix can be filled with a contrast medium under suitable technic Lack of filling must be regarded as a pathognomonic sign of chronic appendicitis

(2) Incomplete filling of the appendix is of a certain importance for the diagnosis of chronic appendicitis

(3) Localized tenderness on palpation over the appendix, especially when the appendix itself cannot be filled or but incompletely filled, is to be regarded as pathognomonic for chronic appendicitis

(4) Limited mobility of the appendix, especially in combination with other symptoms and signs must be regarded as a positive sign of appendicitis

(5) Changes in the cecum and ileum may be regarded as secondary indirect signs

(6) Even filling of the appendix without tenderness on pressure speaks for a normal appendix Changes in form without fixation and without tenderness to pressure are of no significance

(7) Roentgenologic investigation for appendicitis is of importance and should be employed in every case as the diagnosis is facilitated and indications for the extent of the operation are determined

(In reporting the authors' conclusions it is not our intention to subscribe to the statements made without any qualification — *Abstractor*)

H A JARRE, M D

Spontaneous Chronic Appendicitis Maurice Cerf Bruxelles Med, Nov 18 1934 15, 65 (Reprinted by permission from British Med Jour March 23, 1935 p 47 of Epitome of Current Medical Literature)

The author points out that, while in acute appendicitis the symptoms are markedly local in the chronic form they are connected with distant organs any of which may be affected this renders diagnosis extremely difficult Gastric and intestinal symptoms most frequently occur the former being the most common indications of the appendicular condition Failure of all gastric treatment is strongly indicative of chronic appendicitis Intestinal conditions are frequent concomitants of chronic appendicitis, if pain is the only subjective intestinal symptom an anterior appendicitis is probably present Hepatic, renal pulmonary and cutaneous affections may also accompany chronic appendicitis Clinical and radiologic signs vary with the site of the organ In antero-cecal appendicitis the type especially present in the young direct radiologic signs are present but indirect ones are rare as the perivisceritis is of late appearance In retro or latero-cecal forms which are rather toxic or dyspeptic few direct but many indirect, signs are present

Concerning the prognosis, cure by operation can be expected in antero-cecal forms, but in the other types, though operation eradicates the progressive infection, it does not suppress the painful or toxic symptoms of the perivisceral complication Hence, a guarded prognosis should be given in cases showing extremely marked indirect signs

BLOOD DISEASES

Roentgen Therapy of Diseases of the Blood R Pape Wien klin Wchnschr, Nov 30, 1934 47, 1459 (Reprinted by permission from British Med Jour, March 16 1935, p 44 of Epitome of Current Medical Literature)

According to the author, x radiation must now be regarded as indispensable in treatment of blood diseases, in which its efficacy is due to the special radiosensitivity of cells showing special anabolic activity In polycythaemia the II Medical Clinic in Vienna has for the past two years used the method of Sgalitzer, in which intensive irradiation of the long bones is replaced by general irradiation in small doses (30 r, or up to 90 r in resistant cases) frequently repeated After five treatments a further blood count must be done, for a diminished leukocyte count calls for a halt the red cell count sinks after a few treatments and may remain normal for some years In agranulocytosis similar treatment is sometimes beneficial if given early In leukemia, Pape still prefers irradiations of the spleen (and possibly liver) to general treatment in myelogenous—and of the lymph glands in lymphatic—leukemia Treatment must be broken off before the white cell count diminishes to normal, for they subsequently undergo further reduction Accordingly, persistence of splenomegaly is in itself no indication for continued treatment Since the vascular walls in leukemic patients are particularly sensitive, extreme care is necessary in dosage of patients exhibiting a hemorrhagic diathesis Remissions rather than cures are to be expected

Other conditions in which x radiations of spleen and/or liver are often beneficial are hemophilia essential thrombocytopenia idiopathic metrostaxis, splenomegaly with lipoxanthomatosis, and splenomegaly with hypochromic anemia masking an aleukemia

BONES (THERAPY)

Two Cases of Congenital Atrophy of Thumb Reconstruction by Bone Graft C Parisel Le Scalpel, Nov 10, 1934 87, 1591 (Reprinted by permission of British Med Jour March 9 1935 p 40 of Epitome of Current Medical Literature)

The author reports two cases of congenital atrophy of the thumb in which reconstruction was attempted by means of a bone graft The first case occurred in a girl of 5 years, whose right thumb consisted only of a short, thin stump, with two phalanges and a nail at the extremity The thumb was inert, and there was no metacarpo-carpal articulation X rays showed a rudi-

mentary metacarpal, but the part near the carpal bones was missing. Operation consisted of the insertion of a tibial graft in place of the missing metacarpal bone one of the ends of the graft being incorporated with the rudimentary fragment, and the other end put in contact with the trapezium. The hand was then kept in plaster for a month. After two years the thumb has developed into a strong and useful digit. The second case occurred in a child of 2 years and a similar operation was carried out. The thumb was small and atrophic, the thenar eminence was not developed, and there did not seem to be any muscles. X rays showed that the metacarpal bone was absent. The author states that as this is a recent case it is too soon to judge of the result of the operation, but if the graft takes it is hoped that it will be as satisfactory as in the former case.

BONE DISEASES (DIAGNOSIS)

The Roentgen Symptomatology of Kaschin Beck's Disease. W. Graziansky. Fortschritt d. Geb. der Röntgenstrahlen, 1934 50, 367-376.

A follow up report concerning several cases afflicted with this disease demonstrating that the pathologic process without any specific diet and merely under the influence of change of location became arrested. Osseous structure showed decided consolidation, with thickening of trabeculation and some sclerosis. No new premature synostoses developed. Bony growth progressed decidedly during the period of observation.

The conclusion is drawn that environmental conditions and not a constitutional deficiency must be considered responsible for this disease. The paper contains excellent illustrations of typical states of the disease and remarks concerning the differentiation from chondrodystrophy and rickets.

H. A. JARRE, M.D.

BURNS AND INJURIES

Successful Treatment of Radiation Injuries of the Skin. Erich Uhlmann and Grethe Schambye. Strahlentherapie 1935 52, 282-298.

The authors treated a number of radiation injuries of the skin by a radium emanation ointment. One gram of the compound contained from 50 to 100 skin erythema units. After a layer 1 mm thick of the ointment has been spread over the involved area a dressing is applied consisting of some rubberized material and tape. It remains there for eight hours and is then removed. From 30 to 40 treatments may be given at weekly intervals without harm. During the periods between treatments boric acid (2 per cent) bath and ointments are used on the treated areas. Fourteen cases are briefly reported and some photographs of lesions before and after treatment shown. The results were so encouraging that the authors consider radium emanation ointment as the method of choice in treating radiation injuries of the skin.

ERNST A. POHLE, M.D., Ph.D.

CANCER (DIAGNOSIS)

Elapse of Three Years without Recurrence of Cancer Following Lobectomy for Pulmonary Cancer. Successful Termination of Pregnancy during This Free Period. J. Divis. Zentralbl. f. Chir., Sept. 8, 1934, 61, 2087. (Reprinted with permission from British Med. Jour., Jan. 12, 1935, p. 6 of Epitome of Current Medical Literature.)

The author describes a case in which three years after lobectomy for cancer of the lung the patient appeared free from recurrence and had recently given birth to a healthy child. She was aged 34, and had a four year history of dry cough and pain in the chest dating from an attack of influenza. The tumor, the size of a goose's egg lay in the inferior lobe of the right lung, with an extension toward the hilus, microscopically it was a cubo-cylindrical-celled carcinoma of infundibular, not bronchial origin. Its genesis was probably due to a chronic interstitial pulmonary sclerosis. The operation, done in two stages, the latter under pressure, was followed by hydropneumothorax and a chronic empyema which was closed by a third operation fifteen months later. Radium applications, after lobectomy, were made to the region of operation and to a hard enlarged lymph gland above the right clavicle.

CANCER (THERAPY)

Cured Carcinoma of Nose and Antrum. M. H. Shutes. Laryngoscope, November 1934 44, 924-925. (Reprinted by permission from British Med. Jour., Feb. 16, 1934, p. 29 of Epitome of Current Medical Literature.)

The author describes a case of an intranasal papillary squamous-celled carcinoma which was treated by curing followed by x-ray therapy and radium. Five years later there was still no return of the carcinoma so that the result is classifiable as a cure. At the operation the underlying bone was soft, and came away readily. The contents of the antrum were pus, blood and epithelial masses. The bleeding was sufficiently controlled to permit the use of the desiccating current. The antral walls were thoroughly bombarded until they were dry and crisp. The intranasal mass was transfixed several times for five or six seconds with a needle, and thoroughly coagulated. One month later six high voltage x-ray treatments were directed to the nose and left antrum totaling 1350 r units with 0.5 mm copper and 1 mm aluminum filtration. After sloughing had been completed in five days 500 mg. hrs. of radium were given to the left nostril followed by 750 mg.-hrs. to the left antrum. Five months later there was a suspicious area near the alveolar opening so 1200 mg.-hrs. of radium were given to the center of the antrum. The area then diminished in size and disappeared in three months. Reference is made to other successful results lasting for periods of from two to ten years after operation succeeded by x-ray and radium therapy.

Irradiation Treatment of Superficial Malignancies
H Dabney Kerr Jour Iowa St Med Soc, March, 1935, 25, 129-131

In the treatment of superficial malignancies, including carcinoma of the lip, Kerr thinks irradiation is equally as satisfactory as surgery. He says "Good surgery is better than inadequate irradiation and certainly poor surgery is not as satisfactory as irradiation in competent hands. In a large series of well irradiated cases of superficial malignancy, including small lip lesions, one can expect primary healing in from 85 to 92 per cent of the cases." He emphasizes the importance of biopsy and describes his method of treatment.

G E BURCH JR, M D

An Attempt to Imitate Teleradium Therapy with Roentgen Rays Erik Ebbelohj Strahlentherapie, 1935, 52, 338-343

The author used roentgen rays of 170 K V, 3 ma, filtered through 1 mm Pb + 1 mm Cu + 1 mm Al ($H V L_{Cu} = 1.85$ mm) at 10 cm focal skin distance, giving 5 r per minute. This was done in an attempt to irradiate malignancies with roentgen rays under conditions similar to those with the radium bomb. The single dose per field amounted to 480 r, which was given about six or seven times, amounting to approximately 4,000 r per field. The results obtained in 30 advanced malignancies were very encouraging.

ERNST A POHLE, M D, Ph D

The Value of Irradiation in the Treatment of Ovarian Carcinoma John H Harris and Franklin L Payne Am Jour Obstet and Gynecol, January, 1935, 29, 88-93

The authors compare their results following the post-operative treatment of 38 cases of carcinoma of the ovary with 51 patients who were operated upon and received no post-operative irradiation. Their statistical study shows that irradiation is definitely beneficial. However, the results that may be obtained are not predictable. The treatment prolongs life and relieves symptoms viz, pain, ascites and tumor formations. The authors discuss their method of treatment.

G E BURCH, JR., M D

Preliminary Results Obtained by Teleradium Therapy in Carcinoma of the Larynx and Hypopharynx in Lund, 1931-1933 Lars Edling Strahlentherapie, 1935, 52, 200-215

This is a preliminary report concerning the results obtained during 1931-33 in carcinoma of the larynx and hypopharynx with the use of a radium bomb (1,220 mg). An isodose chart is appended showing the distribution of the radiant energy. The total dose applied varied from 52-80,000 mg hr for the larynx and 70-100,000 mg hr for the hypopharynx. In a table the author presents a brief analysis of the cases. Of eight cases of cancer of the larynx five were free from symptoms in December 1934. Of 10 patients with

carcinoma of the hypopharynx, three were still free from symptoms in December, 1934. In view of the small number of patients observed the author refrains from giving a percentage of cure.

ERNST A POHLE, M D, Ph D

The Combination of Radiation Therapy with Chemotherapy in Carcinoma of the Uterus Ludvik Havlasek Strahlentherapie, 1935, 52, 242-246

Sixty-seven advanced cases of uterine carcinoma were treated by injections of from 20 to 60 c.c. of Sodium Hyposulfurosum in combination with Se, Cu, or Pb. The latter appeared to be most effective. X-ray therapy was applied with the following technique. From 3 to 5 large areas at 35 cm FSD, from 160 to 180 K V, 0.5 mm Zn + 1 mm Al, from 80 to 90 per cent E.D. per area. This was preceded by radium application administering from 35 to 50 mcd filtered through 13 mm brass plus cork and rubber. The results with the combined treatment by irradiation and injection of the above named substances were very encouraging.

ERNST A POHLE, M D, Ph D

Roentgen Therapy of Carcinoma of the Lip with Short FSD H Chaoul Strahlentherapie, 1935, 52, 221-225

The author treated carcinoma of the lip with massive doses of roentgen rays, using an FSD of from 3 to 5 centimeters. Technique. From 50 to 60 K V, 0.2 mm Cu, small fields of from 4 to 26 sq cm, from 100 to 200 r per minute, daily dose from 300 to 350 r, total doses from 4,000 to 9,000 r. In 20 unselected cases the absolute cure amounted to 90 per cent during an observation period of from one to three years.

ERNST A POHLE, M D, Ph D

The Role of Radiotherapy in the Problem of Malignancy E E Shepley Canadian Med Assn Jour, March, 1935, 32, 252-258

Shepley reviews the subject of radiotherapy in the treatment of malignancy. He discusses the development, more recent advances, and future of radiotherapy. His bibliography which apparently is very complete, is not published but may be obtained on application.

G E BURCH, JR., M D

Our Experience with the Fichera Method in Carcinoma Therapy G Schulte and W Lutteken Strahlentherapie, 1935, 52, 247-251

Twenty-two cases of fairly advanced carcinoma were treated with injections of an organic compound developed by Fichera (Italy). The results were quite disappointing.

ERNST A POHLE, M D, Ph D

Purposes and Significance of the Filtration in the Coutard Method J Jovin Strahlentherapie, 1935, 52, 344-348

According to the author, theoretical deductions as well as clinical observations prove that heavy filtra-

tion is essential when using the Coutard method of roentgen therapy. He appreciates the fact that the method is very time consuming but if the selectivity of the radiation is desired the heavy filter is necessary. He does not believe that a study of the effect of irradiation on the skin is suitable for investigating this problem. In his opinion there must be a definite difference between the reaction of the skin, the mucous membrane, the connective tissue and perhaps also of the cancer cell.

ERNST A. POHLE, M.D., Ph.D.

CHEST, COLLAPSE THERAPY

Interlobar Pneumothorax. R. Pohl. *Röntgenpraxis* January 1935, 7, 9-14.

The types of interlobar pneumothorax are divided into three groups. First the free or open interlobar pneumothorax in which air is in communication with the general pneumothorax; this type may be seen rather frequently when the lung is adherent. The second group is the limited interlobar pneumothorax in which adhesions between the interlobar pleura cause an unusual shape of the air pocket in the interlobar fold. The third group is the encapsulated interlobar pneumothorax in which there is no free pneumothorax, the air is encapsulated in the interlobar space only. It has the shape of a lemon or a spindle. Cavities might be hard to differentiate in such cases.

HANS W. HEFKE, M.D.

DOSAGE

The Construction of Small Ionization Chambers without Directional Effect and Their Use in Roentgen Dosimetry. Peter Rosenfeld and Franz Melchart. *Strahlentherapie* 1935, 52, 307-326.

The authors describe condenser chambers of sphere shape which do not show any directional effect. The method of construction developed by them is quite simple. The dependence of the chamber of the wave length was studied by varying tube potential, filter, F.S.D. field size and back scattering. There was a marked influence of the quality (filter) and of the backscatter and a definite influence of field size and focal skin distance. The chamber may be used for determinations of the depth dose on patients. A table with correction factors is given.

ERNST A. POHLE, M.D., Ph.D.

Experimental Investigation of Some Dosage Conditions in the Technic of Roentgen Treatment Used in Sweden. R. Thoräus. *Acta Radiologica* 1935, 16, 169-177.

The dosage of roentgen treatment applied may be re-calculated from the values free in air to the values at the surface. This method was employed before the more perfect ionization chambers were used. It is possible to re-calculate within an accuracy of ± 5 per cent.

G. E. BURCH, JR., M.D.

ERYSIPELAS

Roentgen Therapy of Erysipelas. C. Kruchen. *Strahlentherapie*, 1935, 52, 252-262.

The author emphasizes the fact that roentgen therapy of erysipelas is successful only if properly given. The exposed field must exceed the area of visible involvement. The quality of radiation should be chosen according to the depth of the involvement. Doses of from 10 to 20 per cent H.E.D. usually suffice. If multiple areas are involved, they should not be treated in one single day but the entire treatment should be distributed over a number of days. The author gained the impression that unless there is a direct local effect the patient will not respond to the treatment. He also draws attention to the fact that an initial increase in temperature may occur after the first exposure.

ERNST A. POHLE, M.D., Ph.D.

ESOPHAGUS (DIAGNOSIS)

Varices of the Esophagus. Gerhard Wachner. *Wien klin. Wchnschr.*, Nov. 9, 1934, 47, 1349. (Reprinted by permission from *British Med. Jour.* Feb. 23, 1935, p. 31 of *Epitome of Current Medical Literature*.)

The author states that Wolf in 1928, was the first to demonstrate radiologically and verify at necropsy the presence of varices in the esophagus in a case of portal obstruction. They are due to enlargement of the collateral circulation channels and may cause the most serious bleedings. The most important x-ray signs are (in addition to broadening of the folds at the lower end of the gullet) sinuous light areas which, although inconstant, recur in the same situation, and round, oval, or clover-shaped light areas. Difficulty may be found in diagnosis from sessile carcinomas (which however, are more localized and are associated with loss of distensibility) and from peri-esophagitis in which the contour line of the outward-directed pockets is spur-shaped. In only two among 17 cases of hepatic cirrhosis and two of thrombosis of the splenic vein could Wachner detect esophageal varices by x-rays—one of hypertrophic cirrhosis without ascites, the other of atrophic cirrhosis with ascites. It happens not seldom that radiological detection of esophageal varices is the first objective sign of cirrhosis of the liver, but Wachner describes a case of atrophic cirrhosis in which x-ray findings in the gullet were normal three weeks before death from hematemesis due to varices. Their degree of fullness is dependent on the tone of the esophagus, the abdominal pressure, the position of the diaphragm and the pressure in the systemic circulation.

FOREIGN BODIES

Foreign Bodies in Intestines. Chevalier Jackson and C. L. Jackson. *Med. Rec.* Sept. 19, 1934, 140, 285-286. (Reprinted by permission from *Brit. Med. Jour.* Jan. 12, 1935, p. 6 of *Epitome of Current Medical Literature*.)

The authors describe a method of determining

whether or not to operate in a case of a foreign body in the intestines. They state that so long as it is moving the patient is relatively safe, but if it remains in one spot for four or five days there are grave risks of obstruction or perforation. Daily x ray examinations are useful when applicable but in the case of bodies which are not thus shown an examination for tenderness on palpation is most helpful since, if it is present the abdomen should be opened at once. Complications are most frequent in the case of pins, needles, bones, and relatively long foreign bodies, such as hairpins, in the duodenal turns of children ulceration is likely to occur. No cathartics should be given because the increased contractions of the intestine and the greater fluidity of the intestinal contents hinder the passage of the foreign body and intensify the risk of damage to the wall of the gut. No change should be made in the diet but no bulky or stringy food should be given, since it will set up indigestion and increase peristalsis. As a prophylactic all foreign bodies discovered in the stomach should be removed from thence at once by gastroscopy. With the performance of the daily x ray examination (lateral as well as anteroposterior films) or abdominal palpation should go the careful routine examination of the stools.

The authors state that of 68 patients with recent foreign bodies in their intestines, four died and 64 recovered. Seven developed abdominal symptoms. The foreign body was found to be moving forwards in 55 in this series, but in 13 it became fixed. Of these 13 cases nine recovered the four who died already had peritonitis when admitted to the hospital.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Tumors of Small Intestine T M Joyce Ann Surg, November 1934 100, 949-959 (Reprinted by permission from British Med Jour, March 18 1935 p 44 of Epitome of Current Medical Literature)

The author suggests that tumors of the small intestine are not so rare as is commonly supposed. Relatively few of the tumors are diagnosed before operation or necropsy owing to the vague and indefinite symptoms which they cause. The majority of small intestinal carcinomas occur in or about the ampulla of Vater, whilst the jejunum holds second place in order of frequency. The ileum shows the lowest incidence of carcinoma and the highest of tumors of the lymphoblastoma group, the latter being extremely malignant. The majority of benign tumors consist of adenomas and these occur most frequently in the ileum. They may vary from the size of a pea to that of a walnut and may undergo malignant change. Small intestinal multiple polyps are also found in the small bowel and of all benign tumors in this region are the most prone to become malignant.

The symptoms of tumors of the small intestine are mainly due to the obstruction caused by the growth, and this is usually only partial and intermittent. Intussusception occurs in about 30 per cent of small intestinal tumors and is far more frequent with benign

tumors than with malignant. Hemorrhage is an important sign, and occurs in nearly all cases, although it may be so slight as to be unnoticed by the patient. Pain varies with the locality of the tumor, but is most often felt in the epigastrium or in the umbilical region. It is usually gripping and may be intermittent or constant. The presence of a palpable mass is the most important physical sign and in cases of early malignant and benign tumors there is a characteristic mobility. The x ray is the greatest aid to diagnosis.

Four cases of benign tumors are reported, and these were successfully treated by operation. Of five cases of malignant growth three patients recovered following operation, one died ten days after, and in the fifth case operation was refused.

The Radiological Aspect of Right Upper Abdominal Pain L J Carter Canadian Med Assn Jour, March, 1935, 32, 296-298

In right upper abdominal pain, radiology occupies a significant place. It is employed in the diagnosis of duodenal ulcer, duodenal bands and adhesions, pyloric stenosis, gall bladder disease, liver function, pyelography and visualization of the reticulo-endothelial system with the use of thorium dioxide preparations. Certain precautions are cited as, for instance a barium meal should not be administered in acute intestinal obstruction, gastric and intestinal perforation, etc.

G E BURCH, JR, M D

GASTRO-INTESTINAL TRACT (THERAPY)

Intestinal Invagination in Children L Osteragard Christensen Ugesk f Læger, Nov 15, 1934, 96, 1229 (Reprinted by permission from British Med Jour, March 9 1935 p 39 of Current Medical Literature)

The author discusses the comparative merits of the conservative and operative treatment of intussusception in the light of earlier publications and of his own material, which consists of 54 cases treated in his hospital since 1922. Of the 52 children responsible for these 54 cases as many as 34 were boys. The cases were classified according as they presented one or more of the four cardinal signs: colic, vomiting, hemorrhage, and a palpable swelling. Colic was absent only in one case, vomiting only in three, but hemorrhage per rectum did not occur in 17 cases. Among the 32 patients under the age of one year, there were only two without such hemorrhage whereas only seven of the 22 above the age of one year bled per rectum. In 30 cases a swelling was felt on the right side, and in 18 on the left side or in the epigastrium. The correct diagnosis was made before admission to hospital in 44 cases. In 34 of these 44 cases the correct diagnosis was not however, made until blood had been passed per rectum.

With the exception of two cases in which bloodless reposition was attempted, according to Monrad's system the treatment was operative. The mortality was 16.6 per cent (nine deaths) and during the last five

years of the period under review only one of 25 cases terminated fatally

Even under x ray control there are serious handicaps to bloodless reposition, and though the author considers that such treatment may be legitimate in the first year of life when the intussusception is recent and the general condition is very unsatisfactory, he states that medical opinion at the present time favors operative treatment in principle

Intestinal Invagination in Children Jacob Norden-toft Ugesk f Lager, Nov 29, 1934, 96, 1311 (Reprinted by permission from British Med Jour, March 9, 1935 p 40 of Epitome of Current Medical Literature)

The author considers that there is a growing favor for the treatment of intussusception by a barium enema under x ray control By 1929 he had succeeded in reducing the intussusception by this measure in three out of five cases, one of which terminated fatally By 1930 his cases had risen to 10, still with only the one death By 1933 his cases had risen to 20, still with only the one death Sixteen other children admitted to the hospital for intussusception presented no definitely palpable tumor and as no reliable x ray record was taken, they could not be claimed as evidence of the success of this treatment, although in many of these cases, all of which terminated in recovery, the diagnosis was assuredly as correct as the treatment was beneficial Up to date and after the exclusion of the above 18 children, the author has treated 25 definite cases of intussusception in which, with eight exceptions, an enema under x-ray control restored conditions to normal The eight exceptions were subsequently operated on, and among them occurred the above mentioned death

Turning to the position in France, the author states that most French surgeons give the barium enema under x ray control a chance before attempting an operation They require that the enema be given by a surgeon under conditions permitting accurate radioscopic control, with every preparation made in advance for an operation should the enema fail

GENITO-URINARY TRACT (THERAPY)

Uterosalphingography by Interrupted Fractional Injections A Modified and Improved Technic Mortimer N Hyams Surg, Gynec and Obst, February 1935, 60, 224-228

The author presents a new method of fractional uterosalphingography, which he believes has distinct diagnostic advantages over the accepted methods One important advantage is that this new method is attended with little or no pain whereas in the accepted method severe abdominal cramps are often noted

The preliminary preparation consists of cleansing of the lower bowel by a mild laxative the night before the examination and a soap suds enema the next morning The bladder is emptied and the vulva and vagina are

scrubbed with tincture of green soap and water followed by a pitcher douche of oxycyanide of mercury 1 2 000 at a temperature of 110 degrees F

After a bivalve speculum fitted with the Hyams diagnostic light carrier is placed in the vagina, the cervix and cervical canal are swabbed with a 3 5 per cent solution of tincture of iodine A tenaculum is then placed on the anterior or posterior lip of the uterus and a sterile uterine sound is introduced into the uterine cavity to determine the length and position of the canal The author has devised a flexible tip cannula to replace the usual rigid one This cannula, which is fitted with a syringe and the usual rubber acorn is inserted into the uterine cavity until the shoulder of the rubber acorn fits snugly into the external os With the apparatus in place, a preliminary injection of a small amount of air is then made to determine whether or not there is leakage around the acorn The syringe is then filled with 10 c c of warmed lipiodol and attached to the cannula, which is inserted into the uterine cavity Five separate injections of 2 c c of the opaque medium are made, with an interval between injections for x ray exposure and immediate development of the films The instrument is held in position throughout the examination A final film is made at 24 hours

J N ANÉ, M D

GYNECOLOGY AND OBSTETRICS

Roentgen ray Diagnosis of Placenta Prævia, with Report of Two Cases J Friedman and D O Macdonald Canadian Med Assn Jour, January, 1935, 32, 12-14

The authors cite the hazards of placentography with radiopaque materials and recall reports of fetal death with such manipulations They present two cases of placenta prævia diagnosed by roentgen visualization of the placenta without any special technic, confirming the usefulness of the method previously described by Snow and used successfully in placenta prævia by Ude Weum, and Urner The diagnoses were proved at delivery

WILLIAM A SODEMAN, M D

HEART AND VASCULAR SYSTEM

Dilatation of the Pulmonary Arch in the Roentgenologic Cardiac Silhouette Four Cases of Aneurysm of the Pulmonary Artery L Holst Fortschr a d Geb der Röntgenstrahlen 1934 50, 349-380

Protrusion of the pulmonary arch in roentgenograms may be of quite varying etiology As causes of congenital protrusion the following are mentioned

Congenital anomaly as the result of uneven division of the truncus arteriosus, patent ductus Botalli stenosis of the pulmonary ostium ventricular septal deficiency atrial septal deficiency, transposition of the large vessels, with deficiency in the ventricular system As causes of acquired widening the following are recorded Congestion in the pulmonary circulation as a result of mitral stenosis, cicatricial distortion of the

pulmonary artery to the left, aneurysm of the pulmonary artery and sclerosis perforation of an aortic aneurysm into the pulmonary artery, insufficiency of the pulmonary ostium as a result of endocarditis, peripheral arteriovenous aneurysm, perforation of an aneurysm of the ductus Botalli into the pulmonary artery

Five cases of aneurysm of the pulmonary artery are used to illustrate the discussion of the various possibilities, one of these was confirmed at autopsy. Differential diagnosis even with due consideration of all clinical and roentgenologic symptoms is at times impossible. The collection of more material is desirable.

H. A. JARRE, M.D.

Sclerosis of the Peripheral Veins H. Kapp *Röntgenpraxis*, January 1935, 7, 16-22

Diseases of the veins play only a small rôle in roentgenology, they are phleboliths and phleboscrosis.

Phleboliths are round or oval shadows of calcification in pelvic veins, spleen, subcutaneous angiomas, and rarely in peripheral veins. A case is reported of several hundred phleboliths in the veins of the legs, measuring from one to eight millimeters in diameter.

Phleboscrosis is calcification or ossification in the walls of veins, either diffuse or localized, it corresponds to the calcifications in arteries, which is seen in arteriosclerosis. The calcification is found in the media. Two such cases are described. Small and extensive areas of calcification were seen in some of the veins of the legs, especially the vena saphena. The arteries did not show calcification in these cases. In one case the phleboscrosis was very extensive and the entire vena saphena magna seemed to be a calcified tube. The condition followed after considerable difficulties from varicosities and varicose ulcers.

HANS W. HEFKE, M.D.

THE KNEE JOINT

Surgical Treatment of Benign Tumors of the Knee Joint by Means of the Juvara Operation Ion Grigorescu and Alexander Vasiliu *Brun's Beitr. z. klin. Chir.* Dec. 8, 1934, 160, p. 575 (Reprinted by permission from *British Med. Jour.*, March 16, 1935, p. 44 of *Epitome of Current Medical Literature*.)

The authors allude to increasing adoption of conservative surgery for giant-celled tumors of bone (myeloid sarcoma, giant-celled sarcoma). Instead of amputation they recommend for small tumors, irradiation for somewhat larger tumors, scraping-out and replacement by fragments of bone or cartilage, for large tumors, excision. For large benign tumors of the femur or tibia, near the knee joint, they recommend Juvara's operation: after excision of the tumor from the lower end of the femur (or upper end of the tibia) a "step" being made at the severed end, the excised bone is replaced by an equivalent length of the bisected upper end of the tibia (or lower end of the femur). The graft is obtained by vertical splitting of the bone by saw and is fixed to the "step" by two

circular steel ligatures. The connection of the dislocated hemi-cylinder of tibia or fibula to its fellow which remains in place is strengthened by two pegs.

For prevention of the formation of a pseudoarthrosis, which occurred in two of the five successful cases here described, excision of the articular surface of the healthy tibia (or fibula) is advised.

It is assumed that the diagnosis of a giant-celled bony tumor or other benign neoplasm, such as enchondroma, has been made radiologically, in doubtful cases a frozen section taken during operation will decide, amputation being done when the tumor is histologically malignant.

LEAD POISONING

Diagnosis of Lead Poisoning in Children Michio Kasahara *Klin. Wchnschr.*, Nov. 17, 1934, 13, 1646 (Reprinted by permission from *British Med. Jour.*, Feb. 16, 1935, p. 27 of *Epitome of Current Medical Literature*.)

The author states that lead poisoning is common in Japan because there is no law prohibiting the manufacture of rouge, toilet, and baby powders with lead. In infants, lead is ingested with the mother's milk. Poisoning occurs in infants of 6 to 24 months, breast-fed from mothers who may show no signs of the disease. They never suffer from the adult manifestations of colic, blue line on the gums, radial paralysis, hematuria, porphyrinuria or urobilinuria. There are two types of case: (1) Lead anemia, with lessened red blood corpuscles, low color index, increased reticulocyte count, and basophil erythrocytes in severe cases poikilocytosis, anisocytosis, and polychromasia are present, and in this type the infants are restless, lose weight, sometimes vomit, and have a black deposit on the neck of the teeth. (2) Lead meningism, which is a seasonal condition occurring only in spring and summer. Examination of the cerebrospinal fluid shows increased pressure, xanthochromia, increased albumin, globulin, and sugar, and lymphocytosis. The fontanelle bulges, there is tremor of the hands, and convulsions occur. The diagnosis of infantile lead poisoning is usually easy from the history and symptoms.

The author states that the percentage of the basophil erythrocytes is in constant ratio to the P_{H_2} , and that a P_{H_2} of 5.54 is the best for Manson's old colorization method.

In addition to the blood picture the x-rays are typical. A thick, broad band is seen at the end of the long and short bones and along the edge of the flat bones. The author found that Lewin's test was positive in 65 per cent of cases. The skin is cleaned with alcohol. A crossed incision with a vaccination lancet is made through a drop of 25 per cent sulphur sodium solution. In a few hours, with a positive result, blackening of the skin occurs.

THE LIVER

Roentgenologic Demonstration of Perforated Echinococcus of Liver and Spleen F. Berner and F. Meyer

thaler Fortschr a d Geb der Röntgenstr, 1934, 50, 337-342

This is a case of spontaneous perforation of an echinococcus of the liver to the bile ducts. The course of the perforation could be demonstrated roentgenologically with a reasonable degree of reliability.

The authors also report a case of spontaneous perforation of an echinococcus of the spleen to the splenic flexure of the colon with roentgenologic demonstration of the perforating sinus.

There is illustration of the diagnostic value of kymography in a case operated on repeatedly for echinococcus of the liver. H A JARRE M D

THE LUNGS

Reaction of Lung Tissue to Roentgen Rays Rolf B Engelstad Strahlentherapie, 1935, 52, 299-306

The author studied the histologic changes in the lungs of 101 rabbits following exposure to roentgen rays. A wide range of doses were used (up to 9,000 r) and several qualities of radiation of from 65 K.V (unfiltered) up to 175 K.V 7 mm Cu. He distinguishes four stages of reaction. First, the initial stage which appears within a few hours after the exposure. It is characterized by degeneration in the lymph follicles and some changes in the bronchial epithelium. The second stage is the latent period lasting from two to three weeks. The third stage represents the main reaction. There are degenerative changes in the bronchial epithelium and stroma with inflammatory processes the degree of which depends somewhat on the amount of radiation received. They are at a maximum during the first or second month and then slowly change to the fourth stage, which consists mostly of regenerative processes. There is increasing proliferation of connective tissue with sclerotic changes. The histologic changes in the lungs are most marked after doses which produce definite skin reactions (from 2,200 to 7,040 r). Six months after the exposure the reaction usually has subsided; sometimes however, there are still signs of degeneration in the bronchial epithelium. The mortality among the animals was very high after doses of 9,000 r or higher. In conclusion, the author states that the type of reaction was more or less the same for all doses and qualities of radiation used in his investigations. The degree of the reaction was dependent upon the total dose as well as upon the intensity of the radiation.

ERNST A PORLE M D, Ph D

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A peri pancreatic abscess (pseudo-cyst of the pancreas) is reported. It developed slowly after a chronic gall bladder disease without severe or typical attacks of pancreas necrosis. The roentgen findings before and after perforation into the stomach are described. There was a pancreatic sequestrum visible in the abscess cavity. The clinical and roentgenologic diagnosis

was made by the history of the preceding cholecystopathy, the finding of sugar in the urine, and the absence of clinical and roentgenologic findings suggestive of a gastric lesion which might have caused a perforation.

HANS W HEFKE M D

PELVIMETRY

A Comparison of Clinical and X ray Pelvimetry Norman H Williams Western Jour Surg, Obstet and Gynecol, February 1935, 43, 84-91

Williams summarizes pelvimetry clinical and x ray, and concludes from his studies that the former is very inaccurate while the latter is very accurate and should be employed more frequently. X ray pelvimetry will eliminate many operations in cases in which pelvic contractions have been erroneously diagnosed by clinical methods. G E BURCH JR., M D

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Four questions were raised.

- (1) Is it possible to demonstrate the ulcer following suturing?
- (2) What type of changes in the configuration of the organ is produced by suturing?
- (3) Can the cure or healing of an ulcer be demonstrated positively by roentgenologic methods what connections are there between gastritis and ulcer?
- (4) Under what conditions is a gastric resection indicated on the basis of roentgenologic findings?

The first question had to be answered in the negative, insofar as the persistence of an ulcer at the height of the inverted gastric or duodenal fold cannot be demonstrated roentgenologically.

Question 2 — Direct and indirect changes in form and function of the stomach and duodenum which have been operated upon are commonly demonstrable. Rather typical are diverticulum like pockets of the gastric antrum or duodenal bulb, a tubular narrowing or S shaped deformity of the antrum, at times associated with the formation of a pseudo diverticulum, finally a straight rigid bordering and oblique straight course of the lesser gastric curvature. These changes are chiefly produced by peritoneal adhesions. At times a small filling defect produced by the inversion of the portion of the gastric mucosa operated upon can be demonstrated. Furthermore it is not uncommon to observe disturbances of gastric motility and tone including formation of spasm and also changes in gastric secretion. However the diagnosis of true gastritis and duodenitis should be made with great caution.

Question 3—A definite statement as to final healing or cure of a sutured over gastric or duodenal ulcer cannot be made. Such a diagnosis must be made on clinical observation chiefly.

Question 4—Pronounced deformities of the stomach which has been operated on often are observed without any subjective distress on the part of the patient and without demonstrable disturbance of gastroduodenal function. A secondary radical operation therefore, is indicated only when stenosis occurs or ulceration recurs with all characteristic symptoms.

This paper bespeaks a very rational conservative viewpoint in regard to treatment of the ulcer patient and also well founded clinical and roentgenologic experience. It is to be regretted that no roentgenologic information concerning any of the patients in question prior to the perforating accident is included in this paper, as undoubtedly quite a number of these patients would have shown considerable gastroduodenal deformities and dysfunctions before surgical interference became necessary.

H A JARRE, M D

The Incidence of Gastrojejunal Ulcer Following Gastro-enterostomy J Wilham Hinton and Reynold E Church Surg, Gynec and Obst, January, 1935, 60, 65-73

The authors present in detail a series of 13 cases of gastrojejunal ulcer following gastro-enterostomy. These occurred in a group of 79 patients who had had gastro-enterostomies for peptic ulcers. This represents an incidence of 16.4 per cent of marginal ulcers occurring in the gastro-enterostomies during a five year period. During this interval, 583 patients with peptic ulcers were admitted, and of this group, 440 were unoperated upon before entering the clinic and 90 had been operated on for chronic ulcers. Of the 440 cases unoperated upon, after careful study and selection only 33 patients were referred for operation.

The purpose of the authors' clinic has been to thoroughly study patients suffering from peptic ulcer to investigate the final results of the different methods of medical and surgical treatment. It is believed that frequent observations are necessary to study these cases in order to obtain accurate conclusions. The authors are also of the opinion that the follow up letter is more misleading than helpful in drawing conclusions in these cases. In like manner, any report based on a single observation after one or several years have elapsed following operation, is also misleading.

Since three of the 13 cases of gastrojejunal ulcers occurred seven years after operation, it is believed that a ten year follow up is necessary. In the treatment of these cases medication should be tried for as long a period as the patient progresses satisfactorily. If the patient continues to have pain under medical treatment it usually means that the marginal ulcer is perforating into some adjacent viscus and it is then best to submit the patient to a second operation.

J N ANÉ, M D

PERNICIOUS ANEMIA

Concerning the Question of Roentgenologically Demonstrable Gastric Mucosal Atrophy in Pernicious Anemia R Pape Fortschr a d Geb der Röntgenstr 1934 50, 327-336

The thickness of the gastric mucosa cannot be judged reliably from the caliber of gastric rugæ as these vary in the same individual to a certain degree with the amount of gastric contents, tonus, compression, and position of stomach and patient. In experienced hands the ease with which gastric rugæ may be eliminated from vision by palpation can furnish a more reliable index for the judgment of the gastric mucosa, especially its turgor. Abnormally easy elimination of gastric rugæ was observed in 50 per cent of all cases with pernicious anemia, while of all other individuals it was found in only about 20 per cent. The so-called atrophic elimination of the gastric relief, described by Chaoul never was found in pernicious anemia and probably occurs only in cases of marked atrophic hyperplastic gastritis.

Hyperplastic changes in the gastric mucosa are quite rare in pernicious anemia, but they were observed in two cases of gastric carcinoma complicated by pernicious anemia. In such cases the demonstration of malignant degeneration may be extremely difficult. If it is true that hyperplastic gastritis precedes the development of gastric malignancy, the observation of hyperplastic mucosal changes would seem quite important.

(Observations which depend so much on subjective conceptions cannot be regarded as very dependable.—*Abstractor*)

H A JARRE, M D

RADIATION SICKNESS

The Cause and Treatment of X-ray Sickness F G Dietel and V Probst Strahlentherapie, 1935 52, 270-281

Studies of the blood of patients who developed x-ray sickness after treatment revealed a definite drop in the red blood corpuscles as well as in the blood cholesterol. In preventing or relieving the symptoms, liver extract and cholesterol *per os* proved to be helpful.

ERNST A POHLE, M D, Ph D

RADIUM

Radium Treatment of Carcinoma of the Vocal Cords by the 'Window' Method Roland Müller Strahlentherapie 1935 52, 216-220

Halberstaedter and Seiffert described a method in 1933 which permitted radium treatment of carcinoma of the vocal cord through a window cut into the laryngeal cartilage. The author reports his experience with this procedure. Two applicators were used by him, one contained 6.5 mg on a surface of 1.7 × 1.3 sq cm filtered through 1 mm Au. Another applicator consisted of three screens in tandem, containing 1, 2, and 3 mg, respectively, left *in situ* for from eight to nine days, giving a total dose of about 1,300 milligram-

thaler Fortschr a d Geb der Röntgenstr, 1934, 50, 337-342

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Ewing sarcomas They are highly radiosensitive and irradiation is the treatment of choice. The best results are seen when the protracted fractionated method is used. Of eight patients treated at the Clinic of Prof Schinz, four were alive more than two years after roentgen therapy.

HANS W. HEFKE, M D

THE SKIN

The Permeability of Human Skin for Radium Emanation in Air Gustav Lang *Strahlentherapie*, 1935, 52, 187-192

The author, investigating the permeability of human skin for radium emanation contained in air, placed the patient in an air-tight box which contained a definite amount of radium emanation in gas form. He could show beyond doubt that the human skin is permeable for the emanation under these conditions.

ERNST A. POHLE, M D, Ph D

THE STOMACH

Diverticula of the Stomach Andrew B. Rivers, G. Arnold Stevens, and B. R. Kirklin *Surg., Gynec. and Obst.*, January, 1935, 60, 106-113

The authors review their series of 33 cases of diverticula of the stomach and present in detail 14 cases of this group which were proved by operation or postmortem examination. Including this series of 33 patients with diverticula, 141 cases have been reported in the literature since the first report by Helmont in 1804.

Ten specimens in the authors' series were removed in 10 of 11,234 exploratory operations on the stomach or 1 in 1,235. Four cases were found in the course of 3,662 routine postmortem examinations, or 1 in 917. Roentgenologic diagnoses of gastric diverticula were made in 25 cases of 91,532 routine roentgenologic examinations of the stomach since 1912. The roentgenologic diagnosis of this condition is very difficult as shown by the fact that in six cases of the group in which diagnosis was made by means of the x-ray, exploratory operations revealed only two to be true diverticula; in the four others, diverticular protrusions were found to be due to perforating peptic ulcer or to carcinoma.

The authors suggest the following classification of diverticula: (1) True diverticula; (2) acquired true diverticula consisting of the pulsion and traction types; (3) false diverticula or diverticular formations. The true diverticula are those in which the pouch includes all coats of the gastric wall without evidence that organic disease was the causative factor. These are believed to be congenital. In the acquired, true diverticula while all coats of the gastric wall are present some thinning may be noted. There is also evidence that some pathologic condition has caused the pouching, such as adhesions or a trichobezoar as reported by Schulten. The group of diverticular formations or false diverticula includes those cases in which there is a break in the gastric wall as a result of disease.

The ages of the patients in the authors' series of gastric diverticula ranged from 25 to 59 years with an

average age of 42 years. Sex was not an important factor as six of the patients were men and eight were women.

A review of the literature showed that gastric diverticula occurred most frequently in the cardia, just below the esophageal junction on the posterior wall and usually nearer the lesser curvature. In the group of 14 cases, six diverticula were found immediately adjacent to the pylorus, six at the cardia, and two, some distance from the pylorus on the posterior wall. The sizes of the pouches varied from 1 centimeter in diameter to 7.5 centimeters.

Associated gastric disease was found in four of the 14 cases. In two cases there were ulcers adjacent to the diverticula, in one, an adenomyoma in the diverticulum and a duodenal ulcer and in the final case, a sarcoma in the wall of the diverticulum.

In four cases of the group of 14 diverticula, symptoms were noted which were attributable to the presence of diverticulum, and in four cases symptoms were noted because of the associated gastric pathology.

The diagnosis of a true gastric diverticulum is impossible without the aid of the x-ray as there are no characteristic clinical symptoms. The roentgenologic diagnosis is extremely difficult. Pendergrass has outlined the differential diagnosis of diverticulum and hernia through the esophageal hiatus.

Because of the difficulty of determining accurately the nature of the diverticulum of the stomach, it is believed that with positive roentgen evidence and the presence of indigestion it is safer to advise surgical exploration in these cases.

J. N. ANÉ, M D

The Importance of Insufflation for the Roentgenologic Diagnosis of Gastric Tumors Fritz Eisler *Röntgenpraxis*, January, 1935, 7, 1-8

Sixty-five cases of gastric tumors were examined by the method of insufflation and the results enumerated. The technique is of very great importance. Two different methods have been used: one is insufflation in combination with a contrast material, the other insufflation without a contrast material. Air or gas can be introduced either by a duodenal tube or by administering acidum tartaricum and sodium bicarbonate. One must avoid too much distention of the stomach, and undesirable symptoms such as vomiting and belching can be avoided by giving only 1 gram of acidum tartaricum and 2 grams of sodium bicarbonate. It has been figured out that from 250 to 500 c.c. of carbon dioxide is formed in the stomach and that this carbon dioxide is present for from 5 to 10 minutes. If the stomach is very large and the elasticity has to be tested a large amount of chemicals has to be given. Since small doses are given, there is no danger of perforation. The examination has to be done on an empty stomach: the patient takes 1 gram of acidum tartaricum in 30 c.c. of sugar water. Immediately afterward he takes 2 grams of sodium bicarbonate in 30 c.c. of sugar water.

hours Five cases were treated in 1933, four of those remained well for from one to two years Six cases were treated in 1934 and all were well when seen last (less than a year later) A table shows the results obtained in 74 similar cases treated since 1929 In view of the satisfactory response of the carcinoma of the larynx irradiated through a window in the cartilage, the author recommends this procedure It has the advantage that the exposure is limited to the tumor and that there is no skin reaction Recurrences usually occurred during the first year after treatment and none of the patients whose primary tumor healed developed metastases in the glands

ERNST A POHLE, M D, Ph D

A Contribution to the Technic of Radium Application in Cancers of the Rectum E Hesse Röntgenpraxis, January, 1935, 7, 39-40

Application of radium tubes to an inoperable carcinoma of the rectum is always difficult Proctoscopic application as well as application of the radium by introducing it with a finger is more or less a make shift The author has devised a glass tube with one closed end, to be introduced into the rectum like a proctoscope, allowing visualization of the entire wall After the correct position has been ascertained, the tube is fixed by adhesive tape and the radium is introduced and fixed in this glass tube

HANS W HEFKE, M D

The Measurement of Beta Rays of Radium in r Units H Smereker and K. Juris Strahlentherapie, 1935, 52, 327-337

The authors measured beta rays of radium in r units by means of a small chamber made of carbon The chamber was attached to a Mekapion (Strauss) They found that the intensity of the unfiltered beta rays is two hundred times greater than the intensity of gamma rays, assuming equal amounts of radium One milligram of radium (RaB + RaC) emits, at 1 cm distance 1720 r per hour of unfiltered beta rays

ERNST A POHLE M D, Ph D

SARCOMA

Studies in Bone Sarcoma—III An Experimental and Pathological Study of the Role of the Periosteum in the Formation of Bone in Various Primary Bone Tumors Alexander Brunschwig and Paul H Harmon Surg Gynec and Obst, January 1935, 60, 30-40

In their third group of experiments in their series of Studies in Bone Sarcoma the authors investigated the rôle of the periosteum in the formation of bone in various primary bone tumors In addition to the new bone of tumor-cell origin bone which is not formed by the activity of tumor cells is always sought for in roentgenograms when the diagnosis of bone tumor is considered These areas have been called 'periosteal lifting' or 'reactive triangles'

The authors employed the transplantable neoplasm

known as rat tumor 256, which originated in the abdominal wall Microscopically it was composed of round and spindle cells of various sizes the latter producing collagen Young adult rats were used in the experiments Under aseptic conditions and ether anesthesia transplants from the tumor were inoculated into the medullary cavity and beneath the periosteum of the long bones of the animals The neoplasm grew through and beyond the cortex, elevated the periosteum and caused it to lay down new bone in the form of radiating trabeculae within the tumor

In order to prove that the new bone observed in the first experiment was periosteal in origin the authors removed fragments of tumor, including newly formed bone, from the inoculated femur of some of the animals employed in the first experiment, and implanted these fragments beneath the skin, into the liver, the deep thigh muscles, and into the peritoneal cavity of other rats Two weeks later, when the animals were sacrificed it was noted on microscopic study that the neoplasm had grown profusely but that the fragments of bone were completely absorbed or remained as small dead spicules

It is believed that periosteal elevation may also be an important factor in the production of new bone in those osteogenic sarcomas in which the tumor cells themselves have osteoblastic properties In the microscopic study of these tumors if large sections are made through the entire neoplasm, the general topography of the newly formed bone in relation to periosteum and tumor cells is of considerable assistance in making a more accurate interpretation of the histogenesis of this new bone

It has been stated that the new bone of Ewing's sarcomas was tumor bone and non tumor bone The authors, however, are of the opinion that all of the new bone is of periosteal origin being laid down as the tumor elevates the periosteum It is believed that the so-called 'onion' layers seen in roentgenograms of these tumors are due to alternate periods of rapid and slow growth of new bone of periosteal origin

In the chondrosarcomas of bone, areas of new bone of tumor-cell origin and calcified tumor cartilage are noted irregularly distributed within them However, in the extra-cortical portions of these tumors fine spicules of bone of periosteal origin which radiate from the cortex, may be present

Fibrosarcomas of bone are osteolytic tumors and when arising centrally they destroy the cortex and then elevate and later disintegrate the periosteum Very little or no osteogenic activity is exhibited by the undestroyed elevated periosteum If a few new bony trabeculae are formed they are immediately destroyed by eroding tumor cells and osteoclasts

J N ANÉ M D

The Treatment of Ewing's Sarcoma Results in Zürich R Stewart-Harrison Röntgenpraxis January, 1935 7, 37, 38

About 10 per cent of all malignant bone tumors are

attention is paid almost exclusively to the neutrophils, useful information can be obtained as to the activity and spread of tuberculosis

TUMORS (DIAGNOSIS)

Ventriculography in the Diagnosis of Intracranial Tumor Leonard C E Linton Australian and New Zealand Jour Surg, January, 1935 4, 271-278

Linton considers ventriculography justifiable only in those cases in which cerebral edema has obscured the patient's intelligence so that examination is unreliable, after repeated clinical examinations fail to further the localization of a tumor or when the physical signs are too contradictory to support a diagnosis. However, he believes it wrong to expect too much from ventriculography and objects to the use in diagnosis of minute deformities in the ventricles, because of possible incomplete replacement with air. He draws conclusions on gross abnormalities only. Specifically, conclusions are based on gross displacement or midline shift, gross alteration in the size and shape of the ventricles, and on gross asymmetry or deformity of one ventricle. These changes in the character and location of the shadows serve their greatest purpose in differentiating between tumors above and those below the tentorium. Illustrative cases all proved at operation are reported and diagrams of the ventriculographic findings are included.

WILLIAM A SODEMAN M D

TUMORS (THERAPY)

Roentgen Therapy of Metastases of Malignant Tumors Herbert Herzum Med Klin Nov 16 1934, 30, 1524 (Reprinted by permission from British Med Jour Feb 23 1935 p 32 of Epitome of Current Medical Literature)

The author asserts that radiation by x rays or radium has a beneficial effect on many metastatic new-growths. Too often when metastases occur after operative removal of the primary tumor, it is assumed that nothing else can be done, or that radiation only produces carcinomatosis, and the patient is left to die. In 14 cases of which 12 were cancers of the breast, bronchus, thyroid or uterus and two were sarcomas of the testis, only four cases received no benefit. Metastases in the spine, lung, liver and eyelid were treated. Herzum found, in confirmation with other reports, that metastases in the spine react best to radiation. Manifestations of compression disappeared to a large extent, the general health improved with increase of appetite and weight, and pain was alleviated. In general treatment of metastases should be carried out, unless the primary tumor has progressed too far and the patient's condition is poor.

Contribution to the Problem of Radiation Therapy in Seminoma André Gilhard Strahlentherapie 1935 52, 226-241

Seventeen cases of seminoma are analyzed by the author. 11 of these were treated during the period

from 1924 to 1930. Two patients, one with seminoma of the testicle and one with seminoma of the ovary, remained cured after periods of eight and ten years, respectively. Six cases were treated during the period from 1930 to 1934. Two are alive after an observation period of three years, one is a seminoma of the testicle, the other a seminoma of the ovary. The treatment consisted usually of a combination of operation and irradiation. A few case histories are appended, in each instance the technical data of roentgen therapy are given. Lately the author has administered ovarian extracts combined with irradiation in seminoma of the testicle. However, it is too early to offer any definite conclusions.

ERNST A POHLE, M D, Ph D

THE UTERUS

The Histological Classification of Cancers of the Uterine Cervix and the Relation between the Growth Structure and the Results of Radium Treatment H Chambers Am Jour Cancer, January, 1935, 23, 1-15

Chambers has analyzed 500 cases of cancer of the cervix to determine the relationship between their structure and the results of radium therapy. The method of grading, an inherently difficult problem, is based on the extent of differentiation and degree of cell activity, with a consideration of the general architecture of the growth as well. Squamous-cell types are divided into four grades. Grade I includes all typical cases of the adult common type of squamous carcinoma, Grade II the types composed of the spindle cells, Grade III consists of all cases in which there is a clear tendency to form stratified epithelium, with subgrouping according to extent of differentiation, Grade IV includes all anaplastic growths showing no formation of stratified epithelium. Treatment used is the technique of Forssell modified to improve the distribution of the radium. No modifications were made for various histologic types.

The highest percentage of local cures, 73.8 per cent, was obtained in the squamous group, Grade III transitional type. In adenocarcinoma no evidence of insensitivity to radiation was obtained, local cures occurring in 72.9 per cent of the cases. None of the histologic grades showed a difference of more than 15 per cent in either local cures or in the number of 3-year survivors.

W A SODEMAN M D

VARIED CLASSIFICATIONS

The Nourishment in Cases of Radiological Reaction in the Mucous Membranes of the Mouth and Throat Kule Palmstierna Acta Radiologica 1935 16, 301-303

The reactions following radiological treatment of the mucous membranes of the mouth and throat make it very difficult for patients to take the proper nourishment. In an attempt to remedy this difficulty the author has concocted the following mixture: 1000 gr of milk, 40 gr of butter, 20 gr of wheat flour, 30 gr of

Fluoroscopic examination checks the optimal time for roentgenograms in the standing and recumbent positions. A tumor appears as a bulging of the contour on profile, either smooth or nodular. Flat tumors which are elevated only slightly from the level of the gastric wall, are difficult to see. With more intensive insufflation, the infiltrated region retains its shape while portions with normal elasticity balloon out.

In the majority of the cases insufflation does not offer advantages over the usual barium examination. Tumors situated in the cardia and close to it are a good indication for the use of this method, especially, because the routine examination is very difficult in this area.

An improvement in the results of x ray examination is to be expected when one has to consider the question of operability. The method of insufflation is not very satisfactory in tumors of the pylorus, only occasionally is it possible to add something to the diagnosis made by the barium examination. In extra gastric tumors this type of examination seems to give more information. The insufflation method is to be used only in combination with and as an addition to the examination of the stomach with the barium meal.

HANS W. HEFKE, M.D.

SYRINGOMYELIA

Treatment of Syringomyelia by X rays. E. M. Haworth. *British Jour Radiol* November, 1934, 7, 643-653 (Reprinted by permission from the *British Med Jour* Jan 12 1935, p 8 of *Epitome of Current Medical Literature*.)

The author describes cases of syringomyelia successfully treated by x rays. He thinks that the type of technic adopted is relatively unimportant since so many varieties have proved equally effective. He gives small doses of from 150 to 180 r with hard rays at progressively increasing time intervals. The apparatus consists of a continuous potential condenser unit with a Wintz tube stand. The constant factors are 180 K V., 2 ma., filtration with 0.5 mm zinc and 3 mm aluminum and 30 cm focus skin distance.

The first case was treated within a month of the appearance of sensory changes and reacted immediately. Except for one relapse the progress in subjective and objective symptoms was maintained. In another case, however, although treatment began within three years of the onset, only a few of the symptoms seem to have improved, namely swallowing speech and a return of heat sensation about the affected elbow, knee and ankle joints. There was also no definite evidence that the disease had been arrested, for the muscles of the right arm and leg were becoming involved. A third case showed a definite amelioration in the subjective symptoms without any marked change in the objective signs and a fourth was characterized by a most striking recovery of sensation, freedom from pain and ability to resume work. The importance of beginning treatment early is brought out by another case in which twenty-five years had elapsed between the origination of the

disease and the start of x radiation. The pain was entirely abolished but the development of tetanospasms of the cervical region brought the treatment to an end although there was progressive wasting and weakness of the arms and the lower limbs were becoming increasingly spastic. There was some indication in another case that the pathologic process in the spinal cord has been definitely circumscribed and localized by the x rays.

Haworth adds that the importance of early diagnosis is well brought out in his small series. Whether the compression of the normal neuroglia round the central canal be due to an overgrowth of embryonic glial tissue and nerve fibrils or to proliferating young blood vessels it appears certain that the process may be arrested by exposure to x rays, and that repair is the more likely when there has as yet been no cavity formation and liquefaction.

TUBERCULOSIS, PULMONARY

The Blood Picture in Pulmonary Tuberculosis. Especially the Relation between Sedimentation and Shifting to the Left. Sigurd Cold. *Ugeskr f Læger*, Oct 4, 1934, 96, 1083 (Reprinted by permission of *British Med Jour*, March 16, 1935, p 46 of *Epitome of Current Medical Literature*.)

The author has compared the leukocyte count with the sedimentation test in 125 patients under treatment at Vejle fjord Sanatorium, Denmark, during 1933. The tests were repeated at intervals of a month and all the patients were suffering from active tuberculosis of the lungs or pleura. Normal findings with both tests were by no means rare, but while a normal sedimentation rate was observed both with chronic cases tending toward arrest and with definitely progressive cases a normal leukocyte count was never found associated with recent extension of the disease. It would therefore, seem that in pulmonary as distinct from pleural disease the leukocyte count is superior to the sedimentation test as an index to activity and progress of the disease. This generalization does not apparently apply to tuberculous pleurisy in which the sedimentation rate may be greatly increased while the left hand drift of the leukocyte count is often slight or even non-existent. This difference in the behavior of the two tests in relation to disease of the lungs and pleura, respectively, is of some value in the differential diagnosis. To clarify this point the author refers to the case of a patient whose artificial pneumothorax was complicated by a slight pleural effusion. The temperature was normal and the sedimentation rate slow but there were tubercle bacilli in the sputum with a left hand drift of the leukocyte count. When the patient became febrile it was not at first clear whether the fever was due to an increase of the effusion or activation of the pulmonary disease. The sedimentation rate remained normal while the left hand drift was much increased. The cause of the fever was traced by the x rays to a recent extension of the disease in the other lung. The author concludes that even when the technic of a blood count is so simplified that

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RHIZOMONOMELORHEOSTOSIS

By BERNARD P. WIDMANN, M.D., and WILLIAM R. STECHER, M.D., Philadelphia

CHRONOLOGICAL REVIEW OF LITERATURE

THIS entity was first recorded in the literature by Leri and Joanny (14), in 1922. Their patient, a female, age 39 years, presented herself for examination, to determine the cause of a bony deformity of the left hand, namely, a divergence of the second and third digits, which she ascribed to a fall at the age of 17. A constant dull pain, which was particularly marked nocturnally, commenced approximately eight years prior to the present examination. Several deformities of the upper extremity, left side, associated with limitation of articular motion, were observed clinically. Roentgenographic examination disclosed complex and unique limitation of new osseous formation, to definite portions of the entire single upper extremity. There was conspicuous demarcation between the normal and abnormal osseous development, which presented a peculiar irregularity of contour of the cortical width. The fancied resemblance of this hitherto undescribed process to the appearance of dripping wax along one side of a candle, suggested the name, "hyperostose 'en coulée' sur tout d'un membre" or melorheostose, *viz.*, a candle-flow, streaming itself the entire length of an extremity. Unable to establish an etiologic factor for this rare osseous condition, they considered it to be a developmental defect. Curiously, this original supposition we consider to be the

most probable, after much speculation and theorizing by the various authors.

An analogous case was next reported in 1925, by Lewin and MacLeod (19), who independently recorded the lesions as an "unclassified osteosclerosis." Their patient was a 35-year-old male, who had noticed peculiar swellings in two of his fingers of the right hand, and dated the onset of this condition at the age of six years. A few years after their recognition, similar thickenings of apparently osseous density were noted in the right elbow region. Dull and rather constant pain had been present since the age of 10, and the deformities and limitation of articular movements became progressively worse. Roentgenographic examination revealed increased osseous production, eburnation and sclerosis, with almost complete disappearance of the medulla, resultant of encroachment on the canal by the hyperostosis. The cortical outlines were obliterated along the lateral aspect of the ulna, triquetrum, pisiform, capitate, fourth and fifth metacarpal bones, and the phalanges of the fourth and fifth digits. No definite causative factor suggested itself, and the distribution of the lesions intimated a neurotrophic derangement along the course of the ulnar nerve.

Muzzi (27), in 1926, reported a similar type of bone involvement in a 10-year-old girl, who had complained of swelling of the left knee region, and seeming shortening of

maltose, and the yolk of one egg. This contains 1 100 calories per liter, with 32 gr of albumin, 70 gr of fat, and 80 gr of carbohydrate. The author says that 1.5 liters of this mixture will satisfy one's daily caloric requirements.

G. E. BURCH, JR., M.D.

Studies Regarding the Influence of Roentgen Rays on the Blood Sugar in Man. K. Brochner-Mortensen. *Strahlentherapie*, 1934, 51, 675.

The author studied the effect of roentgen rays on the blood sugar in man. In a few instances he found a slight increase following the exposure. However, the sugar curve following intravenous glucose injection was the same for both irradiated and non irradiated patients.

ERNEST A. POHLE, M.D., Ph.D.

Therapy with Short Electric Waves. Erwin Schliephale. *Strahlentherapie*, 1935, 52, 193-205.

The author, who has done most of the original work with short electric waves, presents a brief discussion

of the technical, biological and clinical principles of this new type of therapy.

ERNEST A. POHLE, M.D., Ph.D.

Roentgen ray Considerations in Injury Cases. William S. Greenleaf. *Jour. Iowa St. Med. Soc.*, March, 1935, 25, 137-139.

The use of the roentgen ray is almost indispensable in the treatment of injury cases. It is used in the diagnosis of fractures, non penetrating wounds which may appear trivial but may prove to be serious (as a ruptured viscus), penetrating wounds, the location of foreign bodies, etc. It has its prognostic application also.

G. E. BURCH, JR., M.D.

Saturation Potentials in Ionized Gases. Erich Both. *Strahlentherapie*, 1935, 52, 143-151.

The author determined the saturation potentials (degree of saturation 98 per cent) for various gases, as for instance, nitrogen, argon, air, oxygen, CO₂, etc. He compared the experimental values with those calculated by a formula and found that there was fair agreement between the two values for nitrogen, argon, air, and oxygen.

ERNEST A. POHLE, M.D., Ph.D.

Meisels (22), in 1928, reported a rather typical case of melorheostosis, involving the right lower extremity of a 25-year-old female. Meisels emphasized a rather characteristic finding in the condition, namely, absence of the process at the levels of duplication, viz, the tibia presented no pathologic changes, the involvement being confined to the fibula. The distal femoral epiphyseal region was affected, with typical evasion of the knee joint, and further involvement of the proximal two-thirds of the fibula. Since the pain complained of by the patient was of a dull aching character, and further considering the prevalence of malaria in the marshy region where the patient resided, he seriously considered this entity as being a manifestation of a malarial infection. Subsequent clinical and laboratory investigations did not lend support to this supposition. Meisels, in attempting to explain the relative shortening observed in certain cases, propounded an ingenious theory: if the pathologic process involved the temporary zone of calcification *prior* to the completion of ossification, there would necessarily result a retardation of growth of the extremity, but if the osseous condensing over-growth of bone occurs in the identical relative site *after* the epiphyseal line has disappeared, no growth restraint could be manifest, but instead, interlocking effect of the articulations and even mechanical bowing of the involved bones might result. However, relative to this hypothesis, the authors and other observers have noted this shortening of the affected extremity, with associated soft tissue atrophy, prior to any discernible invasion of the epiphyseo-metaphyseal juncture. Goldschlag (6), in reviewing this case, suggested an endocrine dysfunction as an etiologic factor, inasmuch as the patient presented trophedema of the extremity, and rather distinct clinical evidence of hyperthyroidism and hypopituitarism. The possibility of these being merely complicating and unrelated entities is none the less to be borne in mind, as this was the only case reported in which enlargement rather than atrophy of the surrounding soft tissue was connoted.

Leri and Lievre (15, 16, and 17), after carefully studying their originally reported case over a period of six years, reported development of new osseous condensations, which was the first absolute roentgenographic proof of the progressive nature of the process. This osteoblastic progression was manifest in the soft tissues, in the muscle tissue of the infraspinatus region of the scapula, and the other, seemingly detached from the second rib site close by. These osseous masses were removed and examined, and were shown to consist of average appearing Haversian canals and marrow which appeared extremely cellular, containing increased numbers of osteoblasts and osteoclasts. No vascular obliterative changes with associated perivascular condensations were reported, as Putti had observed, but instead, there was prominent vascular hyperplasia, with concomitant active ossification occurring in numerous scattered islets of cartilage. These detached islets of bone, they considered as being the end-products of embolic dissemination of released osteoblasts, possibly by some undetermined infectious agent. Upon this rather hypothetical premise, they discarded their original theorization of congenital developmental defect, and accordingly considered the process as being of post-natal origin, probably from 5 to 20 years' duration, and then developing insidiously and progressively until pathognomonic linear distribution of the irregular condensations for a portion or entire length of derivative of an anlage of an extremity occurred. Unless the condition were aggravated by superimposed trauma, the commonly associated symptoms of dull and fugacious osteocopic pain might readily be entirely overlooked.

In 1929, Kemkes (10), reported a case of a 54-year-old machinist, that, parenthetically, is the oldest patient on record, who had complained of dull intermittent pain and slight wasting of the upper right extremity since the age of 42. Recently, loss of cutaneous sensibility was complained of. The osseous lesions corresponded to the continuous single flow variety, commencing in the

this entire extremity since the age of five. Examination disclosed the process of hyperostotic development to have extended from the superior ramus of the left pubis, along the acetabular brim, femoral head, medial aspect of the femoral diaphysis, medial femoral condyle, patella, tibia, talus and all the lesser bones of the medial one-half of the foot, inclusive of the first digit. The lesions were characterized by hyperostosis, with occasional regional discrete sclerosis. Strangely, there was a coincidental finding of "cranio-stenosis," but, Muzzi did not attempt to classify or suggest an etiologic factor for his case.

One year later, Putti (29) reported a case of an 8-year-old girl, who had a deformity of the left foot, which had previously been considered as an ordinary pes valgus, present since the child was 11 months old. One year previous to the roentgenographic examination, the child had complained of pain in this foot. Clinical study revealed shortening of the left leg, with a slight degree of genu valgum, and 4 cm increase in the diameter of the left knee region. The lesions were typically osteoblastic, and the hyperostosis involved the acetabular lip, skipped the femoral head and neck, affected the greater trochanter, lateral aspect of the femoral diaphysis, lateral femoral condyle, sparing the knee joint, and continuing along the lateral aspect of the tibia, talus, calcaneus, and third cuneiform bones. Putti obtained a biopsy from the affected femoral shaft region, and his histopathologic report was essentially as follows: conspicuous obliteration of the vascular lumina, increased vascular pattern, with perivascular ossifications, and atrophic marrow, containing few osteoblasts and numerous osteoclasts. His impression was that the vascular obliterative process was secondary to local sympathetic contractions, and the osteogenetic changes then ensued therefrom. Policard, of Lyons, reviewed the tissue sections, and considered the degenerative process as primary and the condensations secondary, with the vascular obliterations as merely coincidental findings. Putti termed the condition "l'osteoi-

eburneizzante monomelica," and similarly was unable to establish a primary etiologic factor.

Zimmer (39), Perussia and Meda (20) independently reported additional cases of this curious condition, in the year 1927.

Zimmer had examined a man of 32 years, who presented hyperostotic involvement of the left acetabular lip, entire femur, inclusive of head and neck, lateral aspect of the diaphysis and lateral condyle, sparing the knee joint, affecting the fibula, talus, calcaneus and third cuneiform, and third and fourth metatarsals. He considered this entity of what he described as aligned osseous densities, to be resultant of embryonic metameric disturbance. Kauffman (9), reviewing the biopsy sections, reported compact trabeculations, normal Haversian canals, and fibrosis of the bone marrow, which contained islets of active osteoblasts.

In an article considering osteitis deformans and its differential diagnosis, Meda described a case of unstated age and sex, in which the condensations were present on the lateral aspect of the distal humerus, entire radius, central carpal bones, second, third, and fourth metacarpals, and corresponding phalanges. He mentioned that this case presented definite limitation of articular movements and deformity of the affected right upper extremity.

Valentin (37) next reported a complete continuous type of hyperostotic flow in a 17-year-old female, commencing in the region of the right glenoid cavity, and terminating in the second digit. He attached particular importance to the endosteal hyperostosis, causing encroachment upon the normal medullary canal. Clinically, the patient was unable to completely and freely extend and flex the elbow, wrist, and index finger joints, and additionally, there was present distinct angulation of the affected digit, resembling the original reported case of Leri. The onset of the process could be traced to the age of 2 years. Notation was made of absolute shortening of the affected extremity and soft tissue atrophy of the right forearm, there being, comparatively, 2 cm less circumference.

Junghagen, in 1930 (7), recorded an excellent presentation of melorheostosis. His patient was a farmer, who had been complaining of vague rheumatoid pains since childhood, which progressively and recently had produced marked limitation of articular movements of the entire right upper extremity. In addition, loss of muscular strength was complained of by the patient at the time of examination. The lesions were found to extend from the scapula to the tip of the third digit, in an interrupted flow fashion. The process characteristically spared the entirety or portions of certain bones, and the joints. There was a distinct tendency toward obliteration and invasion of portions of the spongiosa, this hyperostosis being mainly endosteal. A section was obtained from the involved olecranon process of the ulna. There was no microscopic evidence of inflammatory change, which again added to the weight of evidence against any possible infectious nature of the process, *i e*, an osteo-periostitis. The general appearance of the section was that of osteosclerosis, with typical compact bone lamellæ, with various angled interlacing trabeculations. The Haversian systems appeared of average normal description, though very slightly diminished in caliber. There was slight but definite decrease in both absolute and relative number of osteoblasts and osteoclasts. The vascular bed presented no abnormal changes. Delving deeply into conjecture regarding etiology, Junghagen proffered the following suggestions:

(1) The limitation and relatively slow progressive nature and development of the process, which was definitely limited to derivation from a single extremity anlage, together with negative complement fixation test for syphilis, militate against any theory of a local organic or even systemic disease, including leukemia, lymphosarcoma, etc.

(2) The lesions resemble the atypical appearance of osteosclerosis of Albers-Schönberg, and even osteitis deformans of Paget, but nonetheless constitute a distinct separate entity, which is readily differentiated

by careful perusal of the roentgenograms, study of the distribution and structure, and finally, the histopathologic appearances, the latter being irrefutably dissimilar.

(3) The theory propounded by Zimmer appears the most rational, as this explains the protracted progressive development of the lesions—clinically encountered or at least inferred from the anamnesis. The lesions appear to be comparable in development to the rate of normal osseous growth.

(4) The local ischemic theory of Putti, and the neuropathic hypothesis of Lewin and MacLeod, patently do not explain the distribution and appearance of the lesions in all the reported cases, for careful perusal of the recorded distribution of the lesions, in the main, did not affirm the regional distribution of the neural segments, and other reliable observers presented diametrically opposite reports relevant to the microscopic tissue study.

(5) The limitation of articular movements is perhaps most likely resultant of mechanical interference by the osseous excrescences resembling exostoses, and is seemingly analogous to osteophytic spur formation concomitant with hypertrophic osteo-arthritis. However, there are observers who justifiably doubt the explanation of the articular motion restriction to be resultant of arthritic changes.

In 1931, Piergrossi (28) presented a case of melorheostosis, which would have disrupted the propriety of the monomelic designation had not the explanation of the derivation of an anlage of a single extremity been proffered previously. His case was that of a 36-year-old male, with characteristic hyperostotic lesions involving the right ilium, ischium and pubis, including the acetabular region. All these sites were massively involved, and the process was less extensive as it descended along the lateral aspect of the femur. The fibula was markedly involved and bowed. Rather typically, the tibia was therefore uninvolved. The lateral row of the tarsal bones, metatarsals, and phalanges were similarly involved. The patient was of the conviction that the lesions were the result

right scapula and descending along the lateral aspect of the humerus, radius, lateral row of carpal bones, and phalanges of the first and second digits. The articulations appeared locked by many hyperostotic processes. Kemkes concurred with Zimmer relative to the theory of the etiology being that of a congenital metameric disturbance. An interesting contribution was the explanation and justification of the qualifying word "monomelic," which, it was argued, should not be discarded, inasmuch as the term "melic" inferentially applies to the anlage or root from which the extremity is derived, and which accordingly might and did include large portions of scapula, ribs, thoracic vertebræ, pelvic bones, inclusive of the fifth lumbar vertebra. Unfortunately an additional qualifying word was not advocated, to include the specification as to derivation from an anlage.

Milani (26), in 1930, reported a case of melorheostosis of the interrupted flow variety, in a male patient, whose age and date of onset of symptoms were not stated. The right lower extremity was involved by the hyperostotic process.

Leri, Loiseleur, and Lievre (18), in the same year, 1930, conjointly added another case of melorheostosis to the literature. They had examined a 39-year-old clergyman, who had been given repeated courses of anti-syphilitic treatment, in the form of bismuth and sulpharsphenamine therapy, for the preceding ten years. This had been administered because of the type of pains, namely, sharp pains in the wrist joint, which were aggravated upon motion and were especially nocturnal and osteocopic in nature, and were becoming progressively worse. No positive complement fixation test was obtained relevant to the assumed syphilitic origin. The information was forwarded by the patient as it had been told to him that, since infancy, his middle finger had been stiff. As was to be expected, in retrospect, no relief of symptoms was obtained by the anti-syphilitic treatment, and curiously the pain had abated somewhat during the summer season. The hyperostosis involved the right upper extremity, com-

mencing at the scapula and extending interruptedly to the second and third digits. Comparing their second case to their original case report, the authors noted common characteristics of osseous flow, a tendency to spare the joints, and effect only in certain regions of bone in which osseous duplication occurred, viz, the radius being intact and the ulna affected. A biopsy obtained from the third metacarpal bone presented negative bacteriologic studies, and the microscopic appearance was that of apparently varying phases of intermingled rarefaction and condensation, with predominance of the latter. These areas of condensation showed decrease in both size and number of Haversian canals, and the rarefactive zones presented conspicuous absence of osteoclasts. There was no demonstrable evidence of inflammatory reaction or vascular hyperplasia, but, rather, actual absence of newly formed vessels and evident lack of customary sanguineous ooze, upon sectioning the gross tissue. The authors concluded that there was an initial resorption of bone and resultant areas of rarefaction and then further excessive reossification. No etiologic factor, again, was determined. An experiment was performed in an attempt to determine the ability of this curious newly formed osseous tissue to continue its growth and reproduction when transplanted. Accordingly, a section of biopsy material removed from a characteristic involved site was transplanted superosteally upon the femur of a monkey. Should this "graft" continue to grow, their theory of "affection parasitaires," i.e., embolic osteoblastic formation, would be supported. The experimental femur was carefully studied over a period of eight months and no evidence of new bone formation was definable and there was complete absorption of the graft.

Kahlstorf (8), in the same year, reported a case of melorheostosis occurring in a man 33 years of age, who had been complaining of dull aching pain for three years prior to the examination. This case was that of the typical interrupted flow type, and was present in the left lower extremity.

had become insidiously thickened, and enlarged irregularly. Three years prior to reporting of this case, paresthesia and other evidences of nerve and muscular weakness were manifest. Both the physical and roentgenographic examinations were pathognomonic of flowing monomelic hyperostosis at this time, as manifested in irregular nodulations of osseous density in the soft structures of the left shoulder girdle, which strongly resembled osteophytic spur formations from the contiguous bone, the one projecting from the costochondral articulation of the first rib, and slightly distant from the affected limb. There were varying degrees of decalcification and eburnation in the affected extremity, which, with associated curvature of the bones comprising the right uninvolvement forearm, led the author to consider the entire appearance as resultant of a developmental disturbance.

The other case of Kraft was a female, 37 years of age, who dated her initial symptoms of pain and limitation of motion of the right hip joint from the age of 23 years. At that time, after considerable study, the process was diagnosed as a low grade osteomyelitis or ossifying periostitis. There was associated leukocytosis of 14,000. The symptoms abated after a short period of disability, without operative intervention, and slight limitation of motion in the hip joint remained. Seven years later, a rather similar recrudescence of symptoms developed, and careful investigation disclosed the presence of monomelic hyperostosis of the partial continuous flow type, limited to the acetabular and femoral regions. Kraft favored the endocrine dysfunction etiology, and stated that this should be considered until further studies show a more likely etiologic factor. He suggested roentgen therapy, but no intimation of evaluation was given.

Kraft (12), in a review of the pathology of melorheostosis, described an additional case observed by Sante in about 1923. This patient was a male, who presented roentgenographic evidence of a circumscribed flow of hyperostosis limited to the

fourth metacarpal bone, right hand, and the apposing proximal phalanx. Studies of this region twenty-one months later demonstrated no discernible changes, the process being considered as stationary or quiescent. Unfortunately, the patient never returned for further study and an examination of the entire extremity was never obtained.

In September, 1932, one of the authors, while attending the Bone Tumor Conference at Johns Hopkins University, heard Dr. B. M. Parmalee, of Bridgeport, Conn., present a case of melorheostosis, occurring in a female 23 years of age, who had been examined elsewhere previously and diagnosed as ossifying periostitis of the right pelvis and proximal portion of the right femur. This case emphasizes a most important point, namely, in any hyperostotic lesion of any part of an extremity, always radiograph the entire extremity. Unquestionably, had this procedure been carried out, the diagnosis would have readily been made, because the appearance of the disease is so pathognomonic that the most important single factor is that of keeping the possibility of this entity in mind. At the time of the initial roentgenographic examination, the patient had been suffering from what was termed rheumatoid pains in the right hip region for the preceding five years. These symptoms of dull aching pain and limitation of motion of the hip joint became progressively worse, and after gestation became wellnigh intolerable. The case presented a very typical picture of the continuous hyperostotic flow, from the right sacro-iliac synchondrosis to the terminal phalanges.

Saupe (33), in 1932, presented an additional case of melorheostosis in a woman aged 27, one of a family of eight children, in whom no osseous pathologic changes were observed aside from scoliosis in two. The parents likewise presented average roentgenologic findings. As a child, the patient had noted a swelling of the ulnar aspect of the second digit, left hand, although painful when firm pressure was applied, it did not interfere with any

of a severe whipping when 14 years of age and a crush injury to the same leg and ankle region 4 years subsequent thereto. A few years prior to the reported roentgenographic examination, the patient had complained of dull pain of an osteocopic nature, associated with limitation of both hip and knee action, and was exempted from military service. The hip and knee joints roentgenographically presented a typical appearance of mechanical ankylosis, but no actual fusion. Piergrossi stressed the appearance of interspersed areas of rarefaction and heterotopic ossification. He considered the following differential diagnoses: (a) Osteopetrosis (marble or chalk bones of Albers-Schönberg), (b) Osteopoikilosis (spotted bone, due to disseminated bone islets in the spongiosa of the skeletal system of bones of non-membranous origin), (c) Osteitis deformans (Paget), (d) Osteitis fibrosa cystica (von Recklinghausen)—atypical form, (e) Congenital or acquired syphilitic osteo-periostitis, (f) Progressive myositis ossificans and fibrositis ossificans fasciæ. He did not subscribe to the developmental defect theory of Zimmer, and favored the local ischemia hypothesis of Putti, with some degree of modification, as follows: primary simple osteosclerosis with practically no change in the contour of the bones, and secondary, periostosis with marked deformity of the osseous contours predominating. The authors are of the opinion that it was most unfortunate that the term "periostosis" was substituted for "hyperostosis," inasmuch as the latter is the correct terminology, and includes both periostotic and endostotic forms, which are frequently concomitant findings.

Rokhlin (31), in 1931, reported a case of monomelic flowing hyperostosis, which presented characteristic findings as contrasted with previously reported cases. His patient was a female of 25 years, with slight involvement of the left upper extremity, the lesions being limited to the medial humeral condyle, ulna, capitae, and the middle and distal phalanges of the third digit. The salient features of the condition, namely, alignment of hyperos-

totic lesions, with absence of articular involvement, and normal appearing intervening osseous structure along the course of the designated "flow," were present.

The following year, 1932, Weil and Weissman-Netter (38), reported a case of "rheostosis" in an army officer, 37 years old, who had been clinically considered as having had malaria and associated polyarthritic attacks at repeated intervals. The history also included pulmonary tuberculosis, and various traumas, which in retrospect had distracted attention from the osteocopic nature of the pain complained of in the right upper extremity. This case proved to be of unusual interest inasmuch as the hyperostotic lesions apparently transgressed the confines of an extremity, which heretofore had been considered as pathognomonic. There was involvement of the fourth rib throughout its entire extent, including its vertebral insertion, the humerus, a few carpal bones, and complete lack of involvement of the radius and ulna. The authors accordingly advocated revision of the current term "melorheostosis" to "rheostose," which would not limit the lesion to one extremity. Again, embryologists brought forward the explanation that the involved limb, and what the writers had considered entirely unrelated contiguous bones, were or could be derived from an anlage for the extremity, which, they explained, occasionally includes the adjacent structures mentioned.

In 1932, interest in this condition was revived by Kraft (11), when he reviewed the literature and added two new cases, one, a 40-year-old male, in whom characteristic lesions involved the left upper extremity. There had been a history of progressive development of the process since the age of 22. Initially, a palpable tumefaction was noted in the left infraclavicular region, together with a rather firm nodule, seemingly attached to the radial aspect of the wrist region. At the age of 30, an irregular thickening of the second digit developed, and at 33, there was an enlargement of the humerus. Three years subsequent thereto, the thumb

had become insidiously thickened, and enlarged irregularly. Three years prior to reporting of this case, parasthesia and other evidences of nerve and muscular weakness were manifest. Both the physical and roentgenographic examinations were pathognomonic of flowing monomelic hyperostosis at this time, as manifested in irregular nodulations of osseous density in the soft structures of the left shoulder girdle, which strongly resembled osteophytic spur formations from the contiguous bone, the one projecting from the costochondral articulation of the first rib, and slightly distant from the affected limb. There were varying degrees of decalcification and eburnation in the affected extremity, which, with associated curvature of the bones comprising the right uninvolvement forearm, led the author to consider the entire appearance as resultant of a developmental disturbance.

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In September, 1932, one of the authors, while attending the Bone Tumor Conference at Johns Hopkins University, heard Dr. B. M. Parmalee, of Bridgeport, Conn., present a case of melorheostosis, occurring in a female 23 years of age, who had been examined elsewhere previously and diagnosed as ossifying periostitis of the right pelvis and proximal portion of the right femur. This case emphasizes a most important point, namely, in any hyperostotic lesion of any part of an extremity, always radiograph the entire extremity. Unquestionably, had this procedure been carried out, the diagnosis would have readily been made, because the appearance of the disease is so pathognomonic that the most important single factor is that of keeping the possibility of this entity in mind. At the time of the initial roentgenographic examination, the patient had been suffering from what was termed rheumatoid pains in the right hip region for the preceding five years. These symptoms of dull aching pain and limitation of motion of the hip joint became progressively worse, and after gestation became wellnigh intolerable. The case presented a very typical picture of the continuous hyperostotic flow, from the right sacro-iliac synchondrosis to the terminal phalanges.

Saupe (33), in 1932, presented an additional case of melorheostosis in a woman aged 27, one of a family of eight children, in whom no osseous pathologic changes were observed aside from scoliosis in two. The parents likewise presented average roentgenologic findings. As a child, the patient had noted a swelling of the ulnar aspect of the second digit, left hand, although painful when firm pressure was applied, it did not interfere with any

activities. The present symptoms began about twelve years previously, following trauma to the third digit of the same hand. The radial aspect of the finger became swollen, the swelling gradually extending to the wrist region. Soon thereafter, she became cognizant of some degree of impairment in motion of the left elbow joint, and soon constant dull pain, of an aching character, became manifest, which was of nocturnal osteocopic nature. The slightest trauma to the affected region elicited marked tenderness. Nodular thickenings were palpable along the first and second metacarpal bones, left side. Mensuration disclosed a difference of 2 cm. in the peripheral measurement of the mid-hand region of the left hand, slight thickening of the left elbow region, and 2 cm. shortening of the left forearm. There was restriction of articular movements of metacarpo-phalangeal joints of the second and third digits, limitation of motion of the left wrist joint, and ankylosis of the left elbow joint, in position of flexion, with no disturbance of the left shoulder articulation. The complement fixation test for syphilis was negative, and no laboratory findings suggestive of tuberculosis were found. The patient's menstrual history had always been irregular, but no further evidence of endocrinal dysfunction was detectable. The roentgenographic findings were characteristic of melorheostosis of the partial continuous flow type.

In 1933, Moore and de Lorimer (25) contributed another case of this rare entity to the literature. Their patient was a man 38 years of age, with a negative family and personal history. The onset of the complaints occurred with swelling of both feet and ankles, associated with a dull ache extending into the calf muscles. This was first observed by the patient during the World War, while he was digging trenches in France. When discharged from the service he was rated 10 per cent disabled due to pes planus. In 1922, on account of lancinating pains in the upper thigh region, a roentgenographic examination was made which dis-

closed "marked density of bone in the region of the greater trochanter of the left femur, spine and hip joints negative." The pains continued unabated, however, in spite of treatment. In the three years prior to the reporting of the case, the pains became progressively increased and well-nigh "unbearable." There was increased muscular weakness and atrophy of the muscles of the thigh and leg regions, with limitation of motion in the entire extremity. Clinical examination revealed perceptible roughening and prominence of the proximal portion of the femur, comparative diminution in circumference of both the mid-thigh and calf regions of the affected side. All laboratory findings, which were carefully and extensively performed, were essentially within normal limits. A complete skeletal roentgenographic examination was made, and these studies revealed the following: an interrupted type of hyperostotic flow, extending from the greater femoral trochanter to the calcaneus, with selective affinity where duplication of skeletal support existed, namely, involvement of fibula and sparing of tibia. At certain areas the lesions resembled disseminated osteites. Throughout there was some degree of endosteosis encroaching upon the medulla, with occasional areas of cortical erosion. Lateral bowing of the femur and postero-medial curvature of the affected fibula were evident.

In an excellent review of the numerous etiologic theories promulgated, these authors suggest a non-infectious osteitis, secondary to subperiosteal telangiectases, for acceptance of this hypothesis would explain the seemingly divergent histopathologic reports, upon the basis of description of actually the same process at various stages of progress, *viz*, the initial stage as seen by Leri, intermediate, by Putti, and the terminal effects by Leri, Loiseleur, and Lievre. Thus, correspondingly, the telangiectasis with ensuing hemorrhage is causative of vascular obliteration, which, in turn, produces increase in newly formed vascular tissue (hyperplasia)—a vicious circle, tending to explain the

cortical erosions with following ossifications, all resultant of subperiosteal hemorrhages. Unquestionably, an exact determination of this supposition would be of immense importance, inasmuch as roentgen therapy should prove to be of great benefit, possibly arrest the disease in its early stages, and cure, within the realm of possibility.

Of the three hypotheses offered to explain the bowing of the involved bones, they consider the theory of unequal tension of muscle groups due to selective muscular asthenia and atrophy the most probable. However, it must be admitted that which is cause and which effect, cannot definitely be decided. Other considerations were undue strain for hypoplastic type of bone, and the result of mechanical leverage effect of hyperostotic processes.

Schor and Hemismann (35), in the same year, reported two cases which they considered as representing what has been described as melorheostosis, in its early phase of development. The one patient, a 20-year-old male, had complained of thickening and interference of motion in the region of the metacarpo-phalangeal articulation of the first digit, right hand. This condition persisted without definite pain for one year. Roentgenographic studies showed involvement of the metacarpal and phalanges by a hyperostotic process, which was both endosteal and periosteal in type. In addition, both sesamoid bones in this site were affected by rather similar changes.

The other case described, a young male, had the symptom of pain in the right radiocarpal articulation. No deformity or actual impairment of movement was demonstrable. Radiographic examination revealed partial sclerosis of the second metacarpal bone, with encroachment on the spongiosa in the proximal metaphyseal region, which markedly narrowed the medullary space at this site. The remaining skeletal system of both patients was of average normal description.

The reports of Sicard, Gally, and Hauge-nau (34), Froelich (3), Rendu and Gay

(30), Kahlstorf (8), and Milani (26) have been included by some writers as variants of this condition, and by others as truly infectious lesions, and therefore have not been alluded to in this review.

Including the authors' case report, a summary of all the reported cases of rhizomonomelorheostosis discloses that the ratio of males to females is as 16 to 9, and the predominance of right to left side is as 15 to 10. The United States leads with number of cases reported, there being a total of seven, Germany contributed six, Italy, five, France, three, and one case each from Poland, Sweden, Russia, and Switzerland. The average age is 25 years, but the most frequent age-period is from 30 to 40 years. The authors' case is the youngest case reported (a patient 6 years old), and the oldest case reported is that of Kemkes, whose patient was 54 years old.

TERMINOLOGY

In deciding upon a descriptive name for this entity, it is important to arrive at a definite conclusion as to whether all the reported cases should be considered as the same process, namely, as a hyperostosis, regardless as to whether there was predominance of, or solely, periostosis or endosteosis, respectively. The prevailing opinion—and in this the authors concur—is that they are both phases of development of the same process, and probably the degree of predominance of either type might be a clue as to the degree the lesion has progressed, but not actually the age of the lesion. It seems relevant that, in the majority of the cases reported, when the patient was relatively young there was predominance of endosteal involvement, but this was also not without exceptions. From this observation, it seems justifiable to infer that endosteal proliferative condensation is the earlier manifestation of the disease, with increased periostotic involvement concomitant, but procrastinated in actual demonstrable development. Since many observers have shown the two processes to be chronologically associated occurrences, it is perhaps best, with our

present knowledge of the entity, to consider these related conditions under the same categorical heading, and not attempt to differentiate the age of the lesion relative to degree of hyperostosis or type of involvement

Various names have been applied to the condition, *viz*, Leri's disease, melorheostosis Leri, osteopathia hyperostotica congenita unius membri, osteosis eburninans monomelica, monomelic flowing hyperostosis, and the recent proposal of Weil and Weissman-Netter, to change the name to "rheostosis" (because in their case, not only was the limb (*melos*) involved, but scapula, and thoracic vertebræ and ribs), and refer to other cases wherein the pelvis and lumbar vertebræ were affected. However, embryologists discount this distinction, if one accepts that the involvement is related to the derivatives of an anlage or root of a single extremity, which includes these apparent exceptions. Accordingly, the addition of the qualifying word "rhizo" (*root* or *anlage*) of an extremity is deemed advisable. Again, since the condition has never been observed to involve more than one extremity, it seems patent that the name must retain a qualifying mono- (single) appellation. Since the process is agreed by all observers to be a hyperostosis including both or either the periosteal or endosteal type, which is analogous to flowing bone, the descriptive term "rheostosis" (*running bone*) is an excellent one. Unfortunately, no etiologic factors have been agreed upon, and even though the congenital assumption is the most plausible, insufficient evidence has accrued to justify inclusion of *congenital* in the name. Thus, recapitulating the different components, the names "rhizomonomelorheostosis," or "rheostosis rhizomonomelica (congenital)," are offered by the authors

ETIOLOGY

Numerous theories have been propounded as causative factors in the production of this entity. Leri considered the possibility of an infectious agent, but in spite of many attempts on his part and

others at bacteriologic isolation, all the experiments thus far have been unsuccessful. Even though histopathologic studies are suggestive of an osteitis, as manifest by a distinct cellular reaction, nevertheless, the absence of systemic symptoms of toxicity and fever, leukocytosis, and other concomitant phenomena, together with bizarre selective affinity and osseous involvement in linear fashion, and constant sparing of the articular sites, all together rather conclusively preclude such an inference.

The neuropathic hypothesis had a few adherents, but no actual proof of the same was in evidence, and most of the cases recorded presented conflicting involvement as regards neural pathways. Putti was the sponsor of the theory of secondary vascular obliterative effects to primary local sympathetic nerve system involvement, with capillary contraction and angiospasm. Thus, there was ensuing osseous eburnation along the course of the nutrient vessels.

Constitutional, endocrinal, and hereditary factors have been suggested, but no unanimity of opinion is established as to their respective merits. The majority of cases reported presented no clinical evidence of endocrine dysfunction. Careful studies in other members of the family showed no involvement, other than the case originally diagnosed.

The infectious granulomas, particularly syphilitic and tuberculous, as causative or even contributory factors, have been rather completely eliminated by laboratory examinations. There never has been suggestive evidence in both the microscopic appearance and clinical course of the disease to suggest, as a remote possibility, a neoplastic nature, either benign or malignant.

Zimmer propounded a very rational explanation, as is observed in reviewing the entire literature concerning this entity. He proffered the embryonic theory of metameric disturbance. This inference is adhered to by the authors and others, and although no case has been shown to have occurred since birth, *i e*, roentgenographic

demonstration, yet, on occasions, the deformity has been noted since birth, and the inference must be that the osseous changes

the pathologic interpretation has been made only from the roentgenographic findings, with comparative estimates to



Fig 1 Original roentgenogram of left elbow region from which a provisional diagnosis of melorheostosis was ventured. Note the definite hyperostosis of the distal end of the humerus and proximal portion of the radius.

noted later in life were causative originally for this deformity. The gradually increasing soft tissue atrophy and lack of complete normal osseous development coincides, as would be expected, with what would occur in ordinary delayed bone growth.

Moore and de Lorimier suggested subperiosteal telangiectases, which might arise either congenitally or developmentally, and give rise to petechial hemorrhages, thereby producing vascular obliterations which, in turn, would excite further telangiectasis. The osseous changes are reaction to the hemorrhage.

One can conclude, from a perusal of the many theories offered, that none explains all the peculiar characteristics of the process, and that many more cases must be found and carefully studied in the light of the prior theories.

PATHOLOGY

There is a paucity of literature concerning the pathology of melorheostosis, for in only five cases were biopsies obtained, and as yet none have come to autopsy. It is apparent, therefore, that considerable of

proven osseous changes which resemble the former.

The essential findings are those of cortical hyperostosis, which consists of dense sclerotic bone, and is either endosteal or periosteal in site, or both. The nature of the lesion is benign and progressive, causing expansion and enlargement in the cross-section of the bone. Although the inherent tendency of the process is toward aligned lesions, which resemble "coulée de bougie" (candle-flow streaming) itself, yet in the pure endosteal type of melorheostosis, no truly defined expansile enlargement of the bones involved is noted. On the contrary, relative and absolute osseous atrophy, particularly in length, has been a rather constant finding, which resembles osseous growth restraint. Most of the cases reported, presented some degree of medullary encroachment by the eburnizing cortical hyperostosis, attesting to the common coincidence of both types of hyperostosis.

In all cases described, the distribution of the lesions was unique in that the derivatives of a single extremity anlage were

affected. Occasionally, seemingly isolated compact islands of bone resembling endostoses have been observed

made by the authors is that endostosis is the earlier development, and that as the lesion progresses, increased hyperostosis

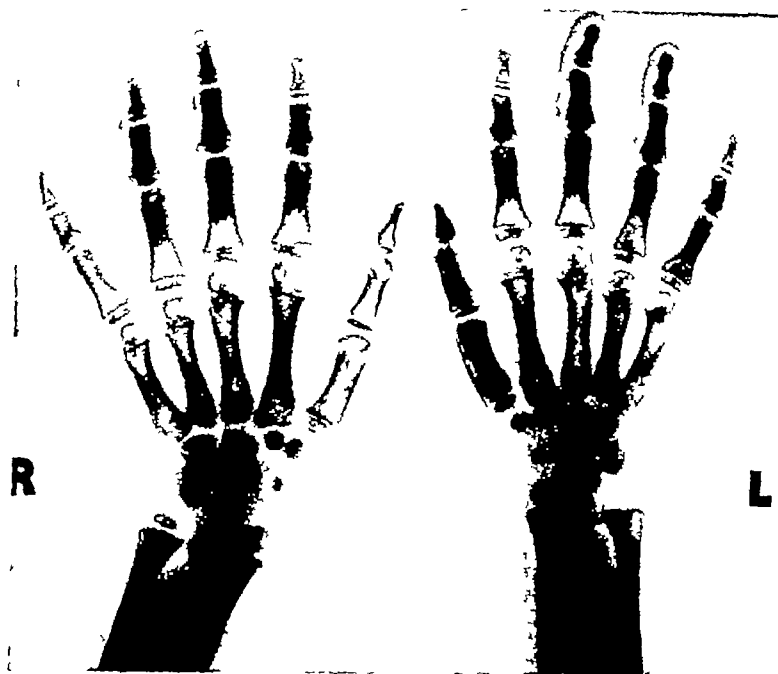


Fig 2 A Note the relative soft tissue atrophy of the left wrist and hand regions. The hyperostosis involves the entire first digit metacarpal and the entire greater multangular.

Kraft attempted to classify the lesions according to their extent, and differentiated between the following:

- 1 Complete continuous flow (far advanced stage),
- 2 Partial continuous flow (advanced stage),
- 3 Interrupted flow (advanced stage),
- 4 Circumscribed flow (early stage)

This classification is excellent, relevant to degree and type of anatomical involvement, but the assumption that the duration and degree of pathologic change is certainly not proven and very questionable. According to it, the authors' case would be considered under Group I, which is deemed as far advanced, and yet the anamnesis, clinical data, and roentgenographic findings are diametrically opposed to this inference. It is perhaps more logical to consider the amount of hyperostosis, and particularly periostosis, as the criterion of the degree of pathologic development. The supposition

continues to increase the width of the eburnating cortex. Furthermore, it is very doubtful indeed if the grouping presents different stages of the entity, for insufficient data have accrued to testify as to the transformation or progress of one group to the other. The common denominator of the various manifestations of the process is its progressive nature, uninfluenced by therapeutic means at our command and present knowledge. This course has been shown in practically all the clinical histories and actually in a few roentgenographic confirmations.

Group I Complete Continuous Flow—This is the rarer form of the disease, and is characterized by hyperostotic extension over the entire extremity, or perhaps better qualified, the derivation of the anlage of one extremity. Dense, osseous tissue, resembling cortical bone, extends as a complete continuous flow from the scapula

or innominate bone, respectively, to corresponding digits. The hyperostotic involvement is most frequently of the periostotic type, but this may be accounted for by the fact that the vast majority of the reported cases was found in mature individuals. Both the periostotic and endostotic flow are typically of irregular sinuous contour, which simulates the course of nerves and blood vessels, but is never actually restricted to their sites. There are occasional ridge-like processes paralleling the long axis of the involved bones.

Group II Partial Continuous Flow—The features of Group I are present, but with limitation of the lesion to approximately one-half of the extremity. In those cases in which the course of the process has been carefully observed over a period of many years, the pathologic entity has not presented any demonstrably increased extent, contrasted with the original examination. The hyperostosis was, however, increased at times, but inconstantly. This phenomenon would lead one to believe that the process from its inception is limited or potentially present at a specific site, and the process, therefore, does not involve any other region or area than its predestined site, its extent being confined to degree of hyperostosis. This belief would strongly favor a congenital defect etiology.

Group III Interrupted Flow—The hyperostotic involvement is interrupted in several sites, the flow *per se* being of either the periostotic or endostotic variety, or both.

Group IV Circumscribed Flow—In this type, the proliferative cortical bone is confined to one metacarpal or metatarsal and a contiguous phalanx. These processes, in the main, have remained stationary over a period of years. The case of Leri, Loiseleur, and Lievre is the only one in which actual roentgenographic evidence was established, showing hyperostosis occurring after an interval of a few years, in what was previously considered a normal humerus. This, however, must not be misconstrued as proving that a circumscribed type of flow has been transformed or progressed

into an interrupted flow, inasmuch as it might conceivably be that the process was dormant and latent, but potentially present from the outset, and through some unknown factor stimulated to development.

Piergrossi (28) considered the development of the disease as occurring in two successive phases. The first phase, primarily osteosclerosis, with slight enlargement and regular contour of the bones, would correspond to the circumscribed type in Kraft's classification. The second phase was considered to be present in adults, and as representing an advanced stage of the former, and as being characterized by considerable irregular enlargement of the involved osseous structures, due to periosteal cortical proliferation, *viz*, periostosis. These observations are significant, and represent in part the authors' deductions, namely, it is probable that the earlier manifestations of the process are, in the main, endosteosis, and the later forms, endosteosis and predominating periostosis.

A constant feature of the disease is sparing of the joints, and only in the exceptional case was there ankylosis noted, and then it was a result of pseudo-bridging by osteophytic excrescences, and not true arthritic changes.

Although superficial analysis would suggest a similarity to osteopetrosis or so-called "marble bones" of Albers-Schönberg, the compact bone in melorheostosis presents no proclivity to fracture. This is an important differential point in addition to the lack of generalized osseous involvement.

Occasionally, heterotopic osseous formations appear as partly confluent masses in the soft tissues, either in the muscular structure or subcutaneously. These bizarre condensations have been noted only in the shoulder or pelvic girdles. This formation can be explained upon the basis of misplaced osteogenetic tissue in the soft tissues, and similarly dispersed through the other involved bones, in characteristic alignment, due to embryologic defective deposition.



Fig 2-B

Fig 2 C

Fig 2 B The flowing hyperostosis is noted to involve the antero-medial aspect of the humerus sparing of the elbow joint and reappearing in the radius in its distal one half. Note the characteristic lack of involvement of the ulna.

Fig 2 C There are scattered areas of rounded hyperostosis in the scapula, coracoid process, base of the acromion and superior margin of the glenoid fossa. There are larger scattered areas of osseous condensation in the antero-medial aspect of the humeral head and proximal metaphysis. The flowing hyperostosis continues along the medial aspect of the humeral diaphysis mainly endosteal.

HISTOPATHOLOGY

In all the cases reported, only five biopsies were performed and histologic study made. In all of the specimens, there was meager cellular structure, and diminished osteoblastic activity, with the sole exception in the instance of an increase in osteoblasts as mentioned by Leri. In general, the osseous lamellæ presented a density and compactness, resembling overcrowding, together with elongation into bizarre formations at various angles. Junghagen (7) considered a concentric arrangement of the lamellæ about the Haversian canals as a rather characteristic differential diagnostic point. Leri and Roussy (32) made an

important contribution, in showing that the heterotopic osseous formations were actually osseous densities containing islands of cartilage.

The majority of observers considered fibrotic replacement of the fat marrow in the medullary canal to be a constant finding, and the vascularity of the tissue to be within limits of normalcy. Putti took exception to the latter observation, thinking that it somewhat resembled a hemangioma. Kauffman (9), in reviewing the section obtained from the patient reported by Zimmer, was unable to report any conclusive features that would be sufficiently characteristic to enable one to make a

diagnosis of any specific disease or entity, such as melorheostosis

SYMPTOMATOLOGY

Unquestionably, this condition has frequently not been recognized clinically, on account of the minimal subjective symptoms, which are often so slight that medical advice is not sought, and it is conceivable that many patients who have similar complaints are not referred to the radiologic laboratory, but merely treated symptomatically, as "rheumatic." In general, the disease is of insidious onset, and the symptoms become progressively more manifest and increased, but protracted in duration. Occasionally, as was the case reported by the authors, the entity has been recognized by a fortunate coincidental examination to an affected region elsewhere. Very few cases have been diagnosed prior to roentgenographic examination by routine clinical methods, but this probably is due to the unfamiliarity of the clinician with the disease, which is diagnosed as some other pathologic entity.

Considering the recent increased incidence of diagnosis of the process, one is led to believe that it is not as rare as was formerly thought, and it is quite possible that numerous cases have been misdiagnosed and therapeutic measures instituted without roentgenographic demonstration of the underlying osseous involvement, attention having been focussed upon the soft tissue atrophy. Again, it is quite reasonable to assume that a certain percentage of the cases remain quiescent throughout life, without presenting symptoms or perceptible deformity.

In the light of recent experience, it is imperative that the referring physician request a radiographic consultation on patients complaining of vague, low grade, periodic osteocopic pain, *confined to one extremity*, and not merely treat the case as "rheumatic" or "neuralgic." This is especially important since the symptoms can abate for a period of months or years, with

progressive increase in degree of involvement and terminal articular motion impairment. As mentioned, the fugacious character of the pain during the period of growth of the disease accounts for the extensive degree of progressive involvement in the majority of cases reported. Although nothing has been proven to have any influence upon the progress of the affection as yet, it is obvious that such progress can only be made if the case is noted early in its course, and opportunity afforded for the institution of various therapeutic measures, of which radiotherapy looms as the most promising.

The initial symptoms, even though frequently overlooked, occur during childhood, and deformity of the extremity may be observed prior to any symptomatic complaint. The deviation of involved digits should always be considered with suspicion, as this has been a rather common finding. Careful clinical examination should demonstrate definite, albeit slight, shortening of the involved extremity, and soft tissue atrophy. This finding likewise is of great importance, due to its being rather constant.

Limitation of articular movements, unfortunately, is a rather late finding, but this may be the first symptom to cause the patient to seek medical advice. Complete disability due to mechanical impedance of joint motion is rarely found. Bowing of the involved bones, which adds to the shortening already present, is practically limited to the femur, tibia, and fibula, which are weight-bearing sites. The musculature of the extremity becomes atrophic and flabby in most instances, and occasionally circumscribed erythema and nodular induration of the skin overlying the affected bones have been noted. Aside from the local affection, the general health of the patient is usually excellent.

To date, laboratory studies, aside from roentgenography, have added nothing to the diagnosis except in a negative sense, such as eliminating syphilis, hyperparathyroidism, etc. However, routine blood chemistry studies, complement fixation

test, and blood counts should be performed with the endeavor to determine some diagnostic feature

tosis of the endosteal type. Primary osseous neoplasm and secondary metastases of the bones rarely will resemble

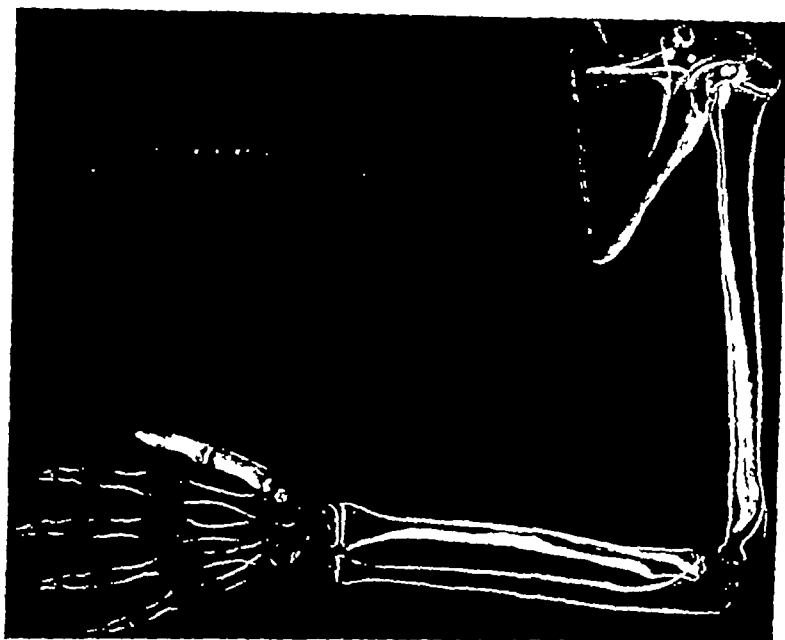


Fig 3 Composite tracing of the entire left upper extremity showing the typical rhizomonomelorheostosis

DIFFERENTIAL DIAGNOSIS

The specific roentgenographic findings and concomitant clinical history described previously are, of course, generally sufficient to formulate a final diagnosis, provided the condition is present in the mind of the examining physician. It cannot be overemphasized that, whenever an osseous lesion is present, particularly a hyperostotic involvement, it is imperative to examine the entire extremity, and even the entire skeletal system. A complement fixation test should always be done, to eliminate the possibility of syphilis, which is probably the most frequent simulant. Tuberculosis might remotely be confusing, as has been reported by Denks (40), but this is always limited to one bone and does not extend from one bone to another. Also, there is calcific deposition in an irregular manner in the medulla primarily, which does not resemble the true bone formation which is encountered in hyperos-

rhizomonomelorheostosis, and the clinical findings and history will serve to differentiate the same.

The partial continuous and the circumscribed flow types of the process will possibly cause confusion, whereas the complete continuous and interrupted flow groups will present a patent diagnosis, provided, of course, the entire affected extremity has been examined. Ossifying periostitis is difficult to differentiate, but the associated soft tissue atrophy, shortening of the affected part, and selective regional involvement in cases in which duplication of skeletal support exists, will serve as differential points. Calcinosis is usually associated with interstitial soft tissue deposition. Osteitis deformans presents characteristic osteoid tissue formation in trabeculated form. Examination of the skull usually will settle the issue, but even in monostotic Paget's disease, the findings are so different from melorheostosis that no difficulty

should be experienced in this regard Garré's non-suppurative sclerosing osteomyelitis may be confusing, but in melorheostosis there is hyperostosis on the one aspect of the diaphysis Osteopoikilosis bears no striking resemblance Calcified hematoma of the subperiosteal type, and aftermath of scorbutus, can be differentiated by the lack of osseous formation and the history of trauma or other evidence of vitamin deficiency Myositis ossificans and calcification in hemophilia present very little to simulate rhizomonomelorrheostosis

Blood calcium and phosphorus studies, and urine estimation of calcium, are indicated if hyperparathyroidism is questioned

Perhaps the most important differential point is the involvement of only derivatives of an anlage of a single extremity, and, accordingly, if osseous lesions exist which are not so demarcated, a presumptive diagnosis of melorheostosis is unwarranted and incorrect

TREATMENT

Since the causative factors are unknown, it necessarily follows that rational therapy must be lacking Roentgen therapy has been attempted empirically upon the supposition that subperiosteal telangiectases exist, but no definite regression or growth restraint or amelioration of symptoms has been reported to date In our own case, we are attempting to determine whether radiation has an effect upon the lesions, by restricting the radiation to one site and employing the remainder of the bone as a control

CASE REPORT

A S, male, age 6 years, was referred to the Radiologic Laboratory for examination of the right elbow region for a possible fracture, by Dr H L Dick

Family History—Essentially negative, particularly as regarding history of osseous dystrophies, etc

Personal History—At the child's birth, both the mother and the attending physician noted a peculiar deviation of the thumb of

the left hand At that time a possible fracture, which might have occurred during delivery, even though the labor was normal and spontaneous, was suspicioned Unfortunately, roentgenographic examination of the part was not made The child did not show any signs of disability as he became older, but the mother stated that although the child had never actually complained of this deformity in the past few months she thought that it did interfere somewhat with proper function of the hand No constitutional diseases aside from measles, were obtained in the anamnesis

Status Præsens—The day of the roentgenographic examination the patient had fallen upon the right elbow, and immediately complained of pain, limitation of motion, and marked swelling was noted Roentgenographic findings revealed the following a chip fracture of the lateral humeral epicondyle, right side Routine concomitant examination of the opposite control elbow region disclosed a hyperostotic involvement of the distal end of the humerus and proximal portion of the radius (Fig 1, p 661) Melorheostosis was strongly suspicioned and diagnosed, provisionally Re-examination of the entire skeletal system definitely established the condition to be that of rhizomonomelorrheostosis Inquiries regarding any subjective symptoms of this affected extremity elicited the information that the patient never had as much strength in this extremity as he thought he should have had, but no aches or pains were ever manifest There was evident restriction in motion of the thumb of the left hand, and the deformity, as described above, the mother stated had been present since birth

Examination of the patient presented definite, although slight, general shortening and atrophy of the entire left upper extremity, the accurate measurements being as shown on page 628

Laboratory Findings—Urinalysis were essentially normal Complete blood count and differential were within normal limits Both the Wassermann and Kahn determi-

test, and blood counts should be performed with the endeavor to determine some diagnostic feature

tosis of the endosteal type. Primary osseous neoplasm and secondary metastases of the bones rarely will resemble

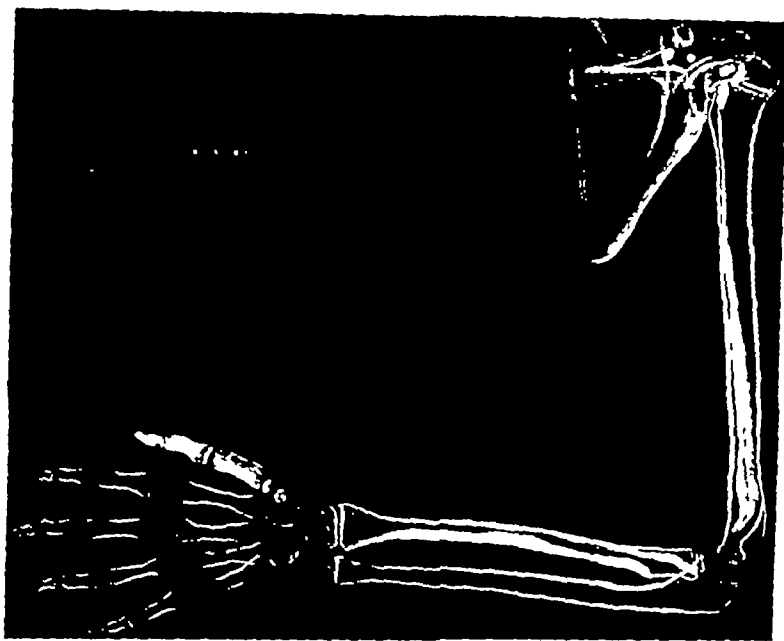


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If this is an early stage of rhizomonomelorrheostosis, which we consider it to be, and by radiotherapeutic measures the process can be made quiescent and stationary, this will obviously be an important observation, not only relevant to curative effect, but as to the etiology of the process, particularly as regards the osteal telangiectatic theory. We are endeavoring to examine this affected extremity at definite intervals, to ascertain whether the entity, *etc.*, the non-irradiated portion, can evolve into different types, during the growth period.

SUMMARY

1 Rhizomonomelorrheostosis is a flowing hyperostosis involving the derivatives of an anlage of a single extremity and pathognomically the remainder of the skeleton is unaffected.

2 Including the authors' report, 23 cases have been described in the literature, and three cases not as yet published have been observed in the United States.

3 The evidence at hand would lend most support to the embryonic metameric disturbance theory, propounded by Zimmer.

4 The classification of Kraft, relegating the lesions into the following types: complete continuous flow, partial continuous flow, interrupted flow, and circumscribed flow, is excellent only in regard to anatomical involvement, and there is nothing to substantiate the inference that the duration and degree of pathologic involvement are related to these types. The hyperostosis is of the endosteal or periosteal type, or both.

5 The histopathology does not present specific features, but in general there was a rather constant finding of fibrotic replacement of the fat marrow in the medullary canal. There is a divergence of opinion as to the significance of concomitant vascular proliferation.

6 The symptoms are occasionally entirely absent, but usually rheumatic, low grade osteocopic pain, confined to one

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nations were repeatedly negative. No clinical signs or symptoms were manifest, to suggest an endocrine dysfunction or altered basal metabolism. No blood smears were taken for possible malarial parasites, and no signs were suggestive of the same. Blood calcium = 10.0 mg per cent, blood phosphorus = 5.3 mg per cent, blood urea N = 12.0 mg per cent, blood sugar = 78.0 mg per cent, all values of which are essentially normal.

Röntgenographic Findings—As shown in Figures 2-A, 2-B, 2-C, and 3, the involvement of the entire left upper extremity conformed to the designated complete continuous flow variety of rhizomeliorheostosis. There was hyperostosis with predominance of the endosteal type except in the first digit, where there was more periostosis manifest than the associated endosteosis. Occasional areas of rounded hyperostosis were noted in the left scapula, coracoid process, base of acromion, and the superior margin of the glenoid fossa. Similar, but larger, scattered areas of osteoblastic condensation were situated in the anterior and medial aspects of the left humeral head and proximal metaphyseal regions. Commencing at the proximal portion of the humeral diaphysis, and medial aspect thereof, there was a rather characteristic hyperostotic flow, of the endosteal type, becoming gradually more extensive in its distalward progress, and confined to the antero-medial portion of the humerus. This process became attenuated in the very distalmost portion of the inferior humeral metaphy-

seal site, then completely spared the articulation of humerus and forearm. The radius was involved to a rather marked degree, from its neck region to the distal metaphysis, confined mainly along the ulnar aspect and to a much less extent along the proximal portion of the lateral aspect of the radius. The carpal articulation, again, was uninvolved. There was curious condensation in the greater multangular, which resembled a condensing osteitis. The entire first digit was markedly involved, inclusive of the metacarpal epiphysis, ulnar aspect of the metacarpal, epiphysis of the proximal phalanx, practically the entire proximal phalangeal shaft, the epiphysis and body of the distal phalanx, with predominating periostotic development. There was gross deviation of the first digit, as described heretofore. The remainder of the entire skeletal system presented no abnormal osseous findings, being of average normal description.

The patient's younger brother, aged 4 years, was similarly examined, and the roentgenographic appearances of the entire torso was found to be average. Roentgenologic examination of the parents disclosed no analogous or other osseous pathologic changes.

Due to the lack of symptomatic complaints of any degree by the patient, it was difficult to convince the parents of the advisability of instituting a therapeutic test of irradiation, employing one-half of the involved area as a control. Permission for this experiment has now been granted us by the parents, and is being conducted

ROENTGENOGRAPHIC MENSURATION

	Left (affected)		Right (normal)	
Humerus	8 ³ / ₄ inches	21.8 cm	8 ³ / ₄ inches	22.2 cm
Radius	6 inches	15.2	6 ¹ / ₂ inches	16.5
Ulna	6 ¹ / ₂ inches	16.5	7 inches	17.7
1st digit	2 ⁷ / ₁₆ inches	6.1	2 ¹² / ₁₆ inches	5.3
2nd digit	3 ¹⁴ / ₁₆ inches	9.9	4 ¹ / ₁₆ inches	10.3
3rd digit	4 ² / ₁₆ inches	10.6	4 ⁴ / ₁₆ inches	10.7
4th digit	3 ¹⁵ / ₁₆ inches	9.9	3 ¹⁴ / ₁₆ inches	9.8
5th digit	3 ⁵ / ₁₆ inches	8.4	3 ⁷ / ₁₆ inches	8.7

Measurements of the Circumference of Arm and Forearm

Arm	7 ¹ / ₂ inches	17.5 cm	8 ¹ / ₄ inches	21.5 cm
Forearm	5 ¹ / ₂ inches	13.8	6 inches	15.0

If this is an early stage of rhizomonomelorrheostosis, which we consider it to be, and by radiotherapeutic measures the process can be made quiescent and stationary, this will obviously be an important observation, not only relevant to curative effect, but as to the etiology of the process, particularly as regards the osteal telangiectatic theory. We are endeavoring to examine this affected extremity at definite intervals, to ascertain whether the entity, *i.e.*, the non-irradiated portion, can evolve into different types, during the growth period.

SUMMARY

1 Rhizomonomelorrheostosis is a flowing hyperostosis involving the derivatives of an anlage of a single extremity and pathognomically the remainder of the skeleton is unaffected.

2 Including the authors' report, 23 cases have been described in the literature, and three cases not as yet published have been observed in the United States.

3 The evidence at hand would lend most support to the embryonic metameric disturbance theory, propounded by Zimmer.

4 The classification of Kraft, relegating the lesions into the following types: complete continuous flow, partial continuous flow, interrupted flow, and circumscribed flow, is excellent only in regard to anatomical involvement, and there is nothing to substantiate the inference that the duration and degree of pathologic involvement are related to these types. The hyperostosis is of the endosteal or periosteal type, or both.

5 The histopathology does not present specific features, but in general there was a rather constant finding of fibrotic replacement of the fat marrow in the medullary canal. There is a divergence of opinion as to the significance of concomitant vascular proliferation.

6 The symptoms are occasionally entirely absent, but usually rheumatic, low grade osteocopic pain, confined to one

extremity, and some degree of loss of strength in the affected extremity are present. Later, limitation of articular movements, pseudo-ankylosis, and bowing of the involved bones, particularly, if weight-bearing function is maintained. The peculiar deviation of the involved digits is so frequently observed in this disease that this finding alone should cause one to suspect the disease, and to demand roentgenographic examination. Absolute soft tissue and osseous atrophy is almost constantly definable.

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CARMAN NIGHT¹

PRESIDENT W HERBERT MCGUFFIN,
M D *Ladies and Gentlemen* We meet here to-night to do honor to the memory of our former confrère and to one of the most outstanding roentgenologists of the first quarter of the present century—a man born a Canadian, naturalized an American and, passing away, recognized by his life's contribution as a world's citizen I refer to the late lamented Dr Russell D Carman, who was one of the foremost figures in American medicine

It has been the custom for us to create a myth concerning our distinguished men who have lived and passed on Later we have gone through the process of brutally debunking them We may save ourselves such bitterness if we try to see Carman as he was in his true perspective

As chief of the roentgen services of the Mayo Foundation, handling thousands of cases every month with the most satisfying results, he will be remembered for his untiring attention and skill Only a man of deep and simple devotion who proclaimed, "My work is my hobby," could have accomplished so much

As a contributor to radiology he was second to none, and there are branches of our specialty to which he made special contributions that will always be associated with his name

He was honored by his fellows who elected him to the highest posts in the various medical organizations of which he was a member He did honor to them all and has left behind him a tradition it will be difficult to emulate His work will be a lasting memorial to his greatness of skill and character, and whilst we grieve at what seemed to us his untimely passing, cut off as he was at the early age of fifty-one, we rejoice to-day for the gifts he spent so freely in the interest of suffering humanity

But to-night I think of him as Carman, the man Those of you who have ever had the big arms of Russell D Carman encircling your shoulders will know something of the thrill which comes to one as we recall his name It was a rare privilege to meet him and an inspiration to know him, and the warmth of his fellowship infected all those who came into contact with him He was never too occupied or engrossed to lose touch with his fellow-man, and his sympathy and understanding endeared him to all who knew him

For that fine humanity it will always be said of him that "to live in the hearts of those we leave behind is never to die"

The keynotes of his character appeared to me to be his courage and discipline—courage in facing every situation and never knowing defeat, and the discipline of his life that gave all he had to the goal he kept before him

Notwithstanding the fact that the American Roentgen Ray Society has placed a tablet to his memory at the Mayo Clinic and that the Minnesota Radiological Society has inaugurated a "Russell Carman Memorial Lecture," your President has felt that in view of the important part that Russell Carman played in the life history of our Society that we, too, should be privileged to offer tribute to him

To this end we have instituted the "Carman Lecture," hoping that we shall make it an annual or bi-annual feature of our program

In honoring the memory of Dr Russell D Carman by establishing the Carman Lecture, it is my privilege to introduce to you Dr B R Kirklin Much thought and time were given by the Mayo Clinic to the possible successor to Dr Carman, and in the appointment of Dr Kirklin to take his place it does seem as if the mantle of Elijah has fallen upon Elisha, and we wish to offer to Dr Kirklin our congratulations for the perpetuation of that fine tradition which his predecessor established

¹ Proceedings of Twentieth Annual Meeting of the Radiological Society of North America at Memphis Tenn Dec 3-7 1934

We are also happy to-night in having with us Dr Donald C Balfour, who will address us on the subject of "The Debt of Surgery to Roentgenology." The time is not so remote when we heard cutting remarks on this subject, but it augurs well for our future when such a well-known man as Dr Balfour, so distinguished in his special field of surgery, comes to us,

and we welcome him with attention and respect. Dr Balfour was also closely associated with Dr Carman for many years and I understand that he will give us some appreciation of his work and life.

Dr Balfour happens to be a Canadian. I sincerely hope that you will not think we are trying to put Canada forward, there are no boundaries in science.

SOME PHASES OF THE ROENTGENOLOGIC DIAGNOSIS OF GASTRIC CANCER

CARMAN LECTURE

By B R KIRKLIN, M D, *Rochester, Minnesota*

Section on Roentgenology, The Mayo Clinic

THE great radiologist whom we commemorate this evening was profoundly interested in the diagnosis of gastric cancer. He made substantial contributions to the science and art of its diagnosis. His criteria for the radiologic identification of gastric cancer, as set forth in his book, are widely followed to-day. He was a victim of the disease and himself made the diagnosis under dramatic circumstances. For these reasons I have deemed the topic appropriate for this occasion.

Although the radiology of the alimentary canal actually began in America with Bowditch's suggestion to Cannon, which resulted in the latter's notable researches on animals, and with the examination of a child's stomach by Williams and Cannon, the capabilities of the new method were not appreciated in this country and the next steps in advance were made by Europeans, but only after many years. When Carman came to Rochester, in 1913, he knew relatively little about gastro-intestinal radiology. When he walked out of the screen room for the last time, now nine years ago, he was undoubtedly one of the ablest radiologic diagnosticians of gastric and duodenal disease in the world. How did he acquire this knowledge and skill?



The late Russell D. Carman, M.D., in whose honor the yearly Carman Lecture has been instituted.

Not by sparkling brilliance of mind or effortless inspiration, but by hard work, well applied.

Carman's mental processes were simple, direct, almost invariably accurate, and, above all, thorough. He thought his problems through. From the older radiologists Carman received less of instruction than of stimulation. He respected their dicta, but never accepted them fully until he had

¹ Read before the Radiological Society of North America, Memphis, Tenn. Dec 3 to 7, 1934.

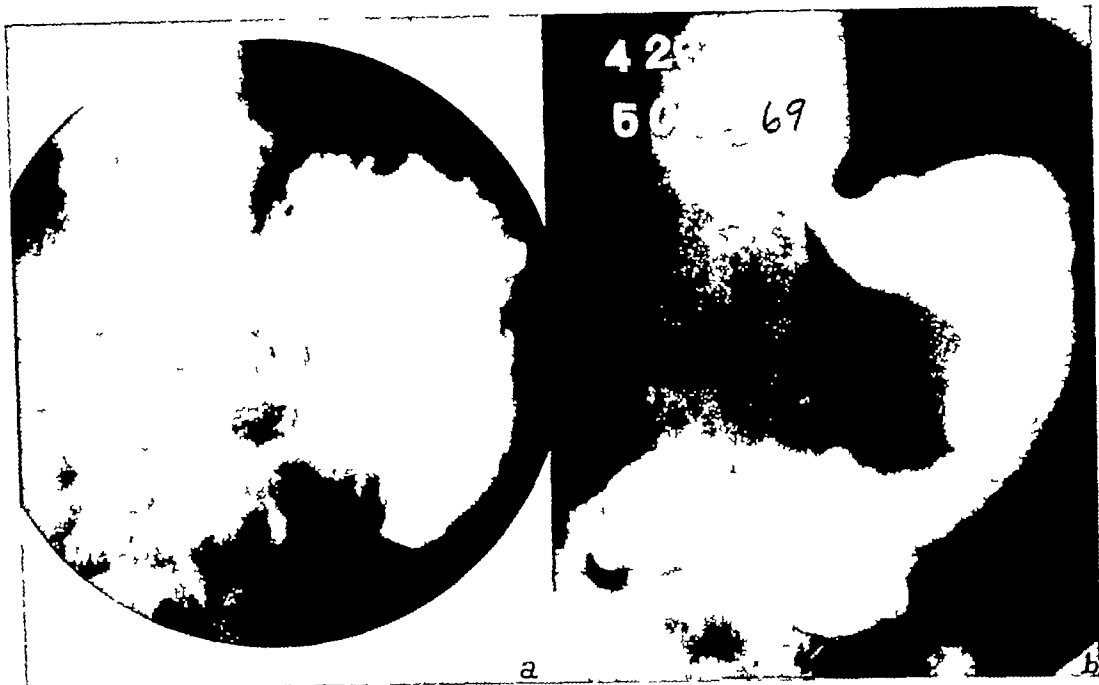


Fig 1-A Extensive ulcerating medullary carcinoma of the distal half of the stomach

Fig 1-B Extensive scirrhous carcinoma of the proximal three fourths of the stomach

proved them by personal observation. So, at the Mayo Clinic, Carman consistently followed his cases to the operating room, the necropsy table, or the pathologic laboratory. Thus all that Carman knew, which was much, he learned at first hand and knew beyond all shadow of doubt. He knew the morbid anatomy of gastroduodenal disease in relation to its radiologic manifestations as few other men have ever known it. His mental picture of gastric cancer, for example, was not derived merely from drawings, or from photographs or lantern slides, but from its varied radiologic images, its appearance when the abdomen was opened, its gross aspects after removal, and its histologic structure as revealed by the microscope, all of which he synthesized into a coherent and practical conception of the disease. Thus Carman not only taught by trustworthy precept but set an example which may well be followed by all radiologic diagnosticians.

MORBID ANATOMY

Every radiologist knows, but he sometimes fails to realize thoroughly, that can-

cer may take the form of a frank tumor, an infiltration, or an ulcer without evident tumefaction. He is aware, too, that not all cancers are extensive when discovered, and that often they are demonstrable when exceedingly small. He knows, further, that although cancer has a preference for certain segments of the stomach, it may affect any part of the viscus. But circumstances impel him to keep much of this knowledge in latent form, and to think idly of cancer as a massive tumor, typical in situation and deforming the barium shadow so grossly and so characteristically that the disease can scarcely escape recognition. It is true, unfortunately, that most cancers are well advanced when their presence is first determined and that, as cancer is essentially a neoplasm, hyperplasia with production of a tumor is a primary trait. But it is to be remembered that cancer is also marked by ulceration, and this feature is scarcely less common than that of tumefaction. Occasionally ulceration is so dominant that tumefaction cannot be discerned with the unaided eye, even on close scrutiny of the excised specimen, and mor-

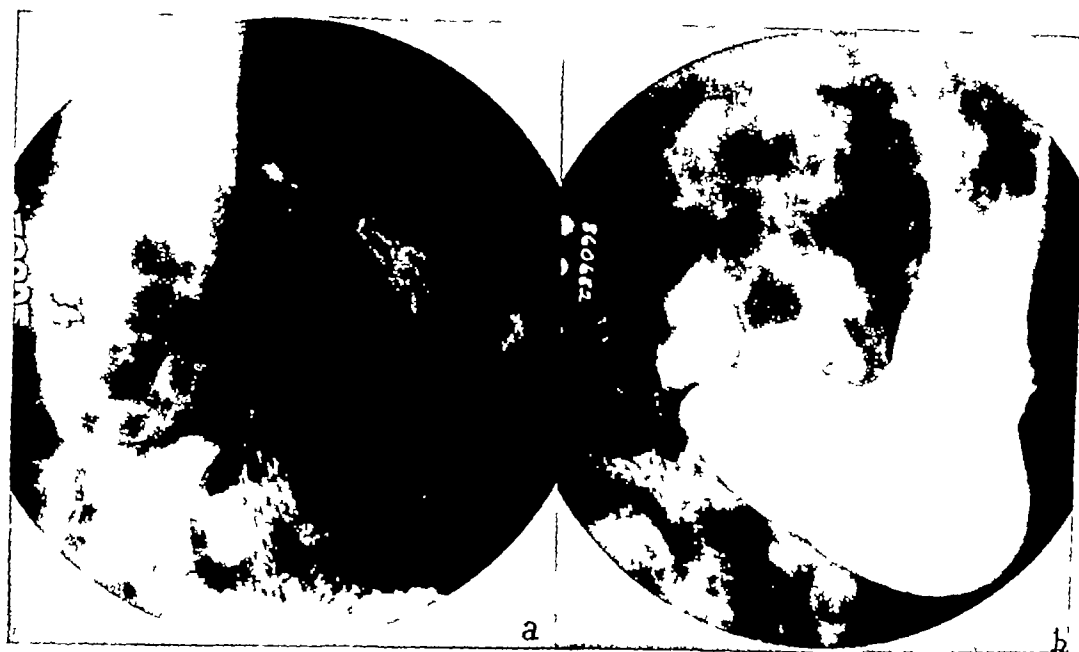


Fig 2 A Internal relief of extensive scirrhus carcinoma

Fig 2 B Early scirrhus carcinoma of the cardia

phologically the lesion must be rated an ulcer. Thus the examiner is obliged constantly to remind himself that cancers range with intermediate gradations from tumors to ulcers and, therefore, may imitate any of the benign lesions. He may also need to stimulate his recollection that the histologic variety and situation of a malignant newgrowth materially affect the radiologic syndrome and the readiness with which the disease can be disclosed and identified. Finally, he will have to resist any tendency to assume that because a lesion is small it is probably not malignant.

TECHNIC

To elicit these morbid anatomic changes, the radiologic examination must be methodical and thorough. It should be radiosopic in order to permit observation at many angles and to carry out the manipulations that are indispensable. Care should be taken to make sure that the patient's stomach is empty, evacuation beforehand with the tube is always desirable and sometimes necessary. It is important that the

patient's abdomen be relaxed completely, so that palpatory investigation may be fruitful. Most important of all is an adequate portrayal of the mucosal relief. Accordingly, at the beginning of the examination the patient should take but one or two swallows of the barium suspension, which should be distributed over the mucosa by manipulation, and the stomach should not be filled until the internal relief has been inspected attentively. The principle of this technical detail can be traced back to Forssell's notable researches on the mucosal folds, and it was applied early by Holzknecht, who realized the significance of certain changes in the internal topography that are demonstrable only in the face view. The latter's followers, among whom was Carman, have habitually included inspection of the rugal pattern in their radiosopic routine. Notwithstanding these facts the potential import of the mucosal relief was not generally comprehended until Akerlund and Berg forcefully called attention to it, introduced technical refinements, and presented the results of their intensive studies. In so doing they have made a substantial contribution to radiology.



Fig 3 A Large phyto bezoar (persimmon ball) in stomach



Fig 3 B Phyto bezoar shown in Figure 3 A



Fig 3 C Pressure defect, upper third of stomach caused by an enlarged spleen the mucosal relief is normal

ADVANCED CANCER

Advanced medullary cancer commonly presents a picture that is almost pathognomonic. The mass projects from a wide base far into the lumen and is represented by a gross defect in the barium shadow. As a rule, the tumor has multiple ulcerous excavations, which appear as pseudo-niches or striking irregularities of its surface or profile (Fig 1-A). The involved portion of the gastric wall is sharply demarcated from the uninvolved portion. The general form of the stomach is likely to be preserved and its capacity diminished only in proportion to the size of the intruding mass. Advanced scirrhous cancer gives rise to a picture that is even more typical (Fig 1-B). With its preference for the pyloric segment and its tendency to encircle the stomach, the infiltrative growth is likely to convert the distal half of the stomach into a funnel, or, if the invasion is more extensive, the barium shadow often takes the shape of a leg of mutton. Ulceration is widespread and occasionally deep in some places, but most of the ulcers are shallow, and the internal aspect of the tumor is smoother

than that of medullary cancer. Often the internal relief has a granular appearance, and the shadow is somewhat like that of ground glass (Figs 2-A and 2-B). I consider this to be an important and rather distinctive mark of scirrhous cancer. Diminution of the capacity of the stomach is a notable feature, and this results not so much from the intrusion of the tumor, as from shrinking, shortening, and loss of expansibility of the affected segment.

Common to both forms are certain physical signs and secondary phenomena. When the disease affects the antral or middle segments of the stomach, both of which are usually accessible to palpation, a mass corresponding to the visible defect or deformity can be felt unless the neoplasm is exceedingly small. Palpability of a gastric tumor is always strongly suggestive of malignancy. Occasionally in scirrhous cancer a mass cannot be felt definitely, but the affected segment is stiffened and slips away under finger pressure. By extension of the cancer to contiguous structures or by the production of adhesions, the stomach may become fixed or less than normally mo-



Fig 4-A Benign angioma in middle third of stomach

Fig 4-B Gross specimen

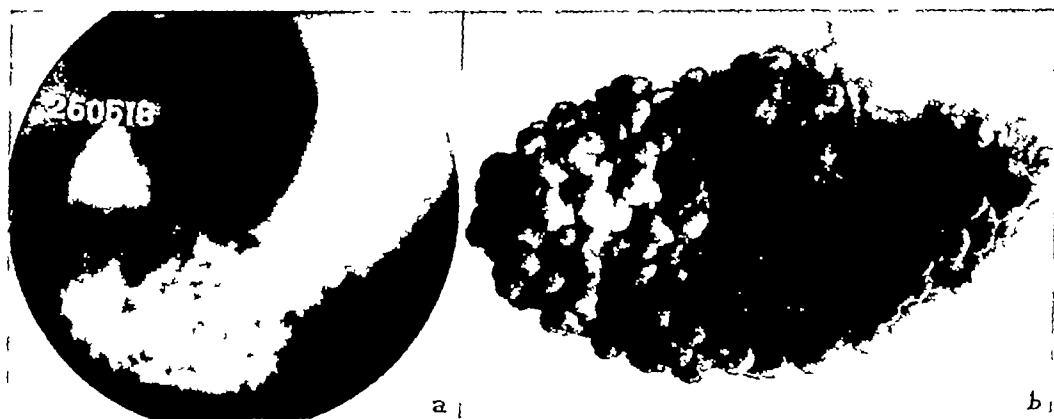


Fig 5-A Polyposis (polyadenomas en nappe) of distal half of stomach

Fig 5-B Resected specimen

bile, and the loss of mobility is determinable by manipulation. With rare exceptions peristalsis is absent in the region of the affected segment, and such absence is of confirmatory and differential value. Moderately obstructive cancer of the prepyloric segment may give rise to hyperperistalsis or antiperistalsis of the uninvaded portion of the stomach, but either manifestation is uncommon. Ordinarily in non-obstructive cancer, peristalsis of unaffected

portions of the gastric wall is less marked than in normal stomachs. Almost without exception gastric motility is notably altered. In the absence of obstruction the pylorus commonly is gaping, the barium suspension flows through it almost continuously, and the stomach is evacuated in much less than normal time. This hypermotility is sometimes attributable in part to stiffening of the pyloric muscle by infiltration, but the concomitant achylia is



Fig 6 A Two small polyps on posterior wall near greater curvature, at juncture of upper and middle thirds of stomach Fig 6 B The polyps, which on microscopic examination proved to be adenocarcinomas of low grade

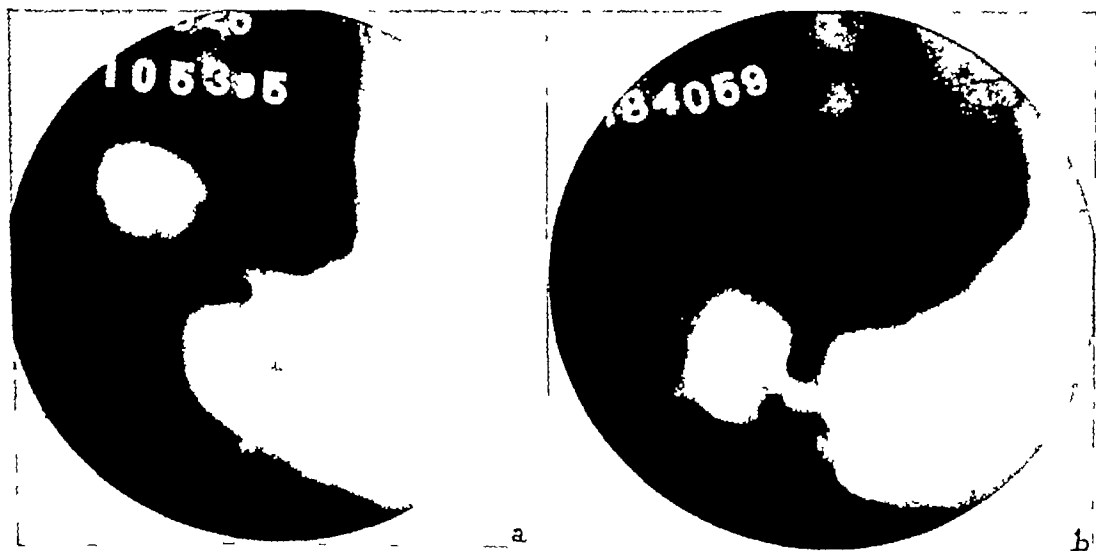


Fig 7 A Small annular prepyloric carcinoma

Fig 7-B Prepyloric ulcer with spastic deformity, the niche of the ulcer is not shown

doubtless the principal causative factor. Obstruction occurs in from 50 to 60 per cent of cases and is evidenced by a residue from the six-hour meal or by scant evacuation during the examination.

DIFFERENTIAL DIAGNOSIS OF ADVANCED CANCER

The first task of the examiner is to determine that the shadow defects, deformities,

and secondary manifestations observed are really due to gastric disease and not to other causes. Among such causes are food or foreign bodies in the stomach, pressure by the spine, ascites, gas or fecal material in the colon, strong retraction of the abdominal wall, extrinsic tumors, and spasm. The simulants are so well known and have been described so often that few of them need to be discussed here.

The bezoars—balls of hair, persimmon seeds, and so forth—have striking features that are practically diagnostic (Fig 3-A) They produce a central reticulated or mottled defect, are often displaceable in the

In contrast with all simulants of disease, the shadow-deformity produced by cancer is persistent as to site and configuration, obliterates the rugal markings, is not altered by manipulation, withstands anti-



Fig 7-C Syphilis affecting the prepyloric segment

Fig 7-D Hypertrophy of the pyloric muscle

stomach, and the contour of the stomach is not altered. But because a bezoar sometimes gives rise to a large ulcer and a definite mass can usually be felt, the examiner is likely to confound it with ulcerating cancer.

Tumors of structures adjacent to the stomach deform the gastric lumen by pressure, and as they are usually palpable, may readily be mistaken for cancer. However, as a rule, an extrinsic tumor can be separated from the stomach by manipulation, and the rugæ are not effaced in the area of deformity (Fig 3-B).

As for reflex gastrosplasm, the test by administering tincture of belladonna to full physiologic effect, as recommended by Carman, is still often applied at the Clinic in suspected cases. It is probable that much that is called spasm is really caused by rigidity and retraction of the abdominal wall or by the patient's apprehension and agitation, and that reflex spasm from non-gastric disease is likely to disappear even when belladonna is not given, but it is safer to employ this test.

spasmodics, and remains unchanged at re-examination.

When it is certain that a lesion is present, cancer may require distinction from benign newgrowths, gastric syphilis, diaphragmatic hernia, or sarcoma.

In most cases the benign neoplasms are relatively small, pedunculated, and multiple but not numerous. They usually produce ovoid, central shadow-defects, can often be shifted to some extent by manipulation, rarely alter the general contour of the stomach, are not often palpable, and seldom inhibit peristaltic contraction at their sites of attachment (Figs 4-A and 4-B). Similar considerations apply to extensive polyposis, particularly the *adenomes en nappe* of Menetrier (Figs 5-A and 5-B). Although Carman had previously seen only one instance of polyposis, he quickly recognized the first case that he saw after he came to the Clinic (Fig 5-A). His associates recall his remark that, on palpation, the stomach "felt like a bag filled with worms" (Fig 5-B). But while benign neoplasms of the stomach usually can be dis-



Fig 8-A (*left*) Ulcerating carcinoma on the lesser curvature which illustrates the meniscus sign-complex
 Fig 8-B (*middle*) Roentgenoscopic demonstration of a small ulcerating carcinoma on the lesser curvature with the typical meniscus sign-complex
 Fig 8-C (*right*) The carcinoma shown in Figure 8-B

tinguished from those which are cancerous, the radiologist should not put too fine a point on this distinction, for newgrowths that appear to have been benign primarily are often found to have cancerous areas indicative of malignant change, and many of the polypoid growths of the alimentary canal seem to be particularly susceptible to such change

It is difficult to evaluate the extent of consideration that should be given to gastric syphilis in the differential diagnosis of cancer. That gastric syphilis occurs cannot be doubted, but its incidence is perhaps more often exaggerated than minimized. At the Clinic less than a hundred cases of what was believed to be gastric syphilis have been encountered. In most of these, the diagnosis rested on clinical, serologic, and radiologic data, together with the effect of anti-syphilitic therapy, and in only a minority of instances was the evidence fortified by microscopic examination of tissue excised from the lesion. From this series of cases it appeared that syphilis of the pyloric or median segment of the stomach may cause deformity imitating that produced by scirrhus cancer, and that more extensive syphilis may closely resemble the variety of scirrhus cancer that is often called fibromatosis. Syphilis rarely, if ever, produces a definitely palpable tumor, and this fea-

ture in conjunction with clinical findings, such as the fact that the patient is below the cancer age or is not ill in proportion to the extent of the gastric lesion, is usually the basis for a provisional diagnosis of syphilis, subject to further investigation.

Hernia of the stomach through the diaphragm, usually of the cardia through a breach in the left arch of the diaphragm or through the esophageal hiatus, is often mistaken for cancer. In both affections the cardiac segment is grossly distorted, and the esophagus is more or less obstructed. However, in hernia the cardiac dome is demonstrably above the line of the diaphragmatic arch and the upper level of the opaque meal is above that of the esophageal aperture, whereas, in cancer, the dome is below the arch and the level of the opaque meal coincides with that of the esophageal opening. Often a gastric ulcer occurs at the point of constriction and may give rise to an inflammatory mass, so that the examiner is likely to suspect that the hernia is associated with cancer.

Sarcoma of the stomach, which is most often lymphosarcoma or other variety of lymphoblastoma, is a rare affection. It has no definite radiologic marks of distinction from cancer, but the examiner may surmise the existence of the condition from the youth of the patient, and general lympho-

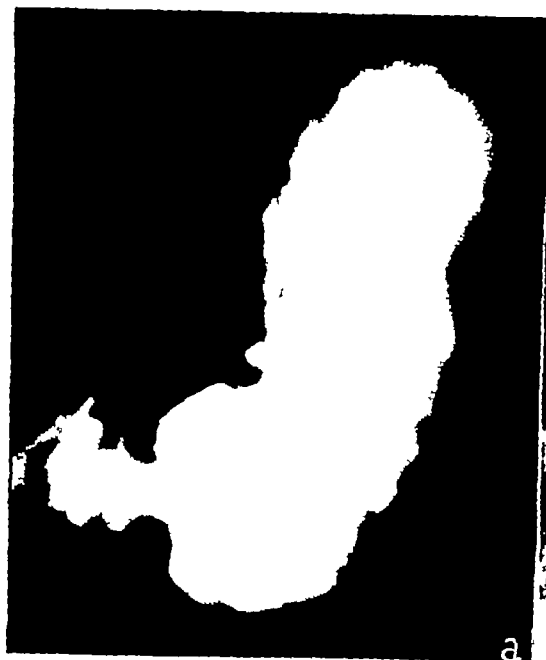


Fig 9 A Perforating ulcer on lesser curvature just above the angle



Fig 9 B The niche of the ulcer has disappeared after three weeks intensive treatment

denopathy or involvement of the mediastinal lymph nodes

On the whole, distinction of advanced cancer from other diseases or the simulants of diseases is not often difficult, provided the examiner is alert in observation and logical in judgment. Small and presumably early cancers are less easy to discern and identify.

EARLY CANCER

Four varieties of early cancer may be considered: (1) small malignant tumors or infiltration without deep ulceration, (2) early prepyloric cancers, (3) small ulcerating cancers, and (4) malignant ulcers.

Small pedunculated medullary cancers without marked ulceration are encountered occasionally. Because they are relatively small and are so often pedunculated they are likely to be mistaken for benign growths (Figs 6-A and 6-B).

Early infiltrating, scirrhous cancer of limited extent is exceedingly hard to disclose, for it seldom produces an obvious marginal defect. Even moderately advanced scirrhous cancer, when confined to

the lesser curvature, is likely to be deceptive, and the unwary examiner may overlook it completely. On casual observation the general form of the stomach appears to be normal, the lesser curvature seems to be smooth, and the lumen is not noticeably narrowed, or, if slight narrowing is evident, it resembles that produced by pressure from an enlarged liver or extragastric tumor. On closer inspection it will be seen, however, that the curvature is abnormally smooth, peristalsis is likely to be absent, and consequently the normal angular incisure is lacking. Localized absence of peristaltic indentations is generally regarded as strongly indicative of a stiffening lesion in that region, but, even though rarely, peristalsis may occur in a cancerous gastric wall. In my opinion, a more convincing and reliable sign of early scirrhous cancer is the granular internal relief which it produces (Figs 2-A and 2-B).

Early cancer of any variety in the cardia may elude discovery unless this region is inspected carefully. Retarded flow of barium from the esophagus, division of the

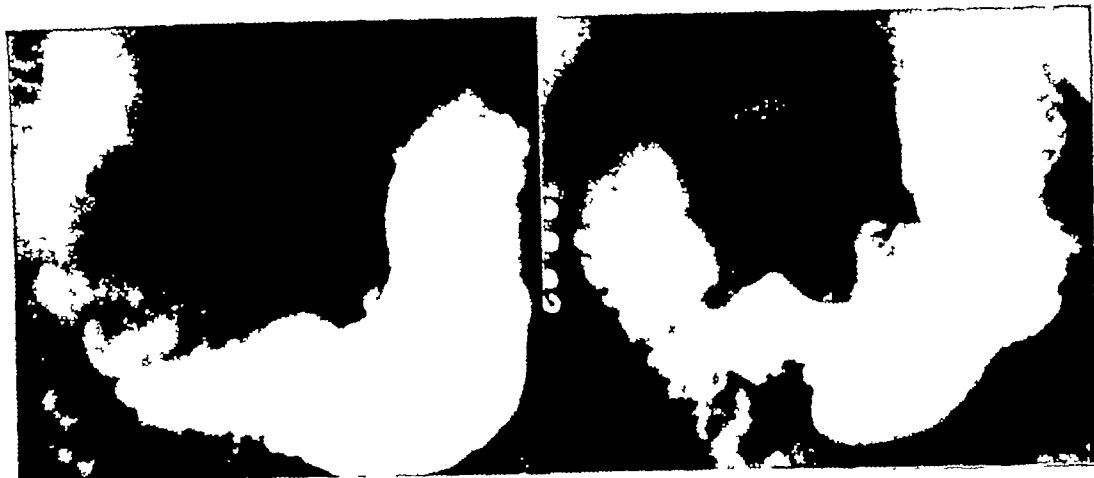


Fig 10 A Perforating ulcer on lesser curvature at the angle with the roentgenologic features of malignancy

Fig 10 B After three weeks' treatment The ulcerating lesion has increased markedly and signs of malignancy are more pronounced At operation an adenocarcinomatous ulcer of Grade 4 was found

barium stream by a small tumor, and deformity of the normally smooth and symmetrical gas-bubble will be found in most cases

Early prepyloric cancers are perplexing, for the antral narrowing that they produce may be imitated by that resulting from hypertrophy of the rugæ, benign ulcer with spasm, syphilis, or hypertrophy of the pyloric muscle (Figs 7-A, 7-B, 7-C, and 7-D) Hypertrophic rugæ usually can be identified by their orderly arrangement, and gastric syphilis is so rare that ordinarily it can be excluded on an empirical basis At the Clinic it has been found that pyloric hypertrophy almost invariably produces a slight invagination of the bulbar base and is marked also by a crevice near the middle of the lower border of the elongated pyloric canal Both marks have a substantial morbid anatomic basis and rarely if ever occur in the other diseases named (Fig 7-D) If a niche is demonstrable, the lesion is certainly an ulcer, but even then the examiner cannot be certain that it is not malignant

Especially interesting are the small ulcerating cancers in which the element of tumefaction is so slight that they may be mistaken for simple ulcers In 1921, Carman noted that in ulcerating carcinoma on the lesser curvature the barium-filled niche

could be separated by manual pressure from the shadow of the stomach, and that it assumed the form of a bi-concave or concave-convex lens as seen edgewise (Figs 8-A, 8-B, and 8-C) If the lesion was on the posterior wall, the niche could be disclosed by pressure as a disc-like shadow surrounded by a transradiant halo

The shape and appearance of the niche led Carman to designate the phenomenon as the "meniscus sign," and he regarded it as a reliable sign of ulcerating cancer Experience has abundantly confirmed his opinion, but if he were living to-day he would probably concede that the shape of the niche is less significant than the slightly elevated border which produces the transradiant halo (Fig 8-B) Often the latter is demonstrable radiologically when it cannot be seen in the excised specimen At all events, the meniscus-complex is practically pathognomonic of ulcerating cancer

Malignant ulcer is a term conveniently reserved for ulcers that, in contrast with ulcerating carcinomas, present neither macroscopic nor radiologic evidence of tumefaction, yet on microscopic examination are found to contain cancer cells It has long been accepted that when the diameter of the crater is 3 cm or more, the ulcer is probably, but not invariably, malignant

When the ulcer is smaller than this, other indications of malignancy have to be considered. Among these are irregularity of the niche, obliteration of neighboring rugæ, absence of gastrospasm or upward curling of the antrum, and lack of tenderness on localized pressure over the niche. Ulcers on the greater curvature are usually, but not always, malignant. Ulcers on the posterior wall or near the pylorus are more likely to be malignant than those on or near the mid-section of the lesser curvature. On the other hand, most niche ulcers are benign, usually the niche is dense, regular in form, lies in the midst of converging rugæ, is sensitive to pressure, and spastic accompaniments are common. Occasionally, however, an ulcer which seems almost certainly to be benign proves on section to be malignant. The effect of medical management (Figs 9-A and 9-B and 10-A and 10-B) on ulcers is a valuable test of their character, but it is not infallible for in least one instance I have seen an ulcer apparently heal under medical treatment, recur after a few months, and when excised prove to be malignant.

I have emphasized the points of distinction between cancer and benign lesions because accuracy in their differential diagnosis is especially desirable. Nevertheless, in the interest of the patient, the examiner should be rather skeptical as to the benignancy of any tumor or ulcer of the stomach. Three-fourths of all gastric lesions exposed on the operating tables of the Clinic are found to be malignant. Unless the radiologist can affirm confidently that a lesion is benign, he should not return this diagnosis without qualification.

OPERABILITY

Concerning the radiologic criteria of the operability of gastric cancer, Carman was well informed. In his book he wrote, in substance, that cancers involving the upper half of the stomach are not resectable, as a rule, whereas those of the lower half are often resectable. He pointed out, also, that in judging the extent of scirrhus cancer

liberal allowance must be made for infiltration beyond the limits indicated radiologically. Free mobility of the stomach, he said, favored resectability of the growth, but fixation made intervention less practicable. These and other pertinent statements in the chapter were written seventeen years ago, yet little can be added now. As a minor item I recall one case in which marked prolongation of the esophagus below the hiatus made it possible for the surgeon to perform total gastrectomy more easily.

That half or more of the gastric cancers are inoperable when discovered is deplorable. That they are so often inoperable is due primarily to the fact that early cancer, unless obstructive, often gives rise to few and petty symptoms or none at all, and the patient has no substantial reason for seeking medical aid. The only way by which such cancers can be revealed is by periodic health examinations, including radiologic investigation of the stomachs of all adults. In a certain percentage of cases the patient asks for advice, but his symptoms are so vague or trivial that radiologic examination seems superfluous. Nevertheless, only by this method can most of the early cancers be found or safely excluded. Obviously, an economic problem is involved, but if the number of examinations is greatly increased, as they should be, an adjustment of fees might be made so that the well-earned wage of the radiologist will not be lowered and the financial burden on the patient will not be onerous.

I congratulate the Radiological Society of North America on instituting this memorial to Russell Carman. His extraordinary ability, his great service to radiology, and his loyal devotion to this Society warrant sustained recognition. I am proud to hold the place that he once filled so ably at the Mayo Clinic, and I thank you for the privilege of participating in this tribute to him.

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THE DEBT OF SURGERY TO ROENTGENOLOGY¹

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MAY I first express my appreciation of the great honor of having a part in the inauguration of the Carman Lectureship which is to-day established by the Radiological Society of North America. The practice of commemorating those whose work has added to medical knowledge is evidence of a desire not only to recognize such accomplishment, but to encourage those of present and future generations in their efforts to further the advance of medicine. Since this Society has shown that it is conscious of these facts, I esteem it a privilege to aid in paying tribute to one of the founders of this association, Russell D Carman, a master roentgenologist, and it will always be a treasured memory that you have accorded me the opportunity of being here on this occasion. Because of intimate association with Carman and my known admiration for his work, I had the privilege of inaugurating the lectureship established by the Minnesota Radiological Society, and the remarks made at that time are equally appropriate here.

Russell Daniel Carman was born at Iroquois, Ontario, March 18, 1875. After preliminary study in Minneapolis Academy, he took the first two years of the medical course in the University of Minnesota. Removing then to St. Louis, he completed his course in the Marion-Sims College of Medicine, receiving the degree of M.D. in 1901. For a year he did graduate work at Johns Hopkins Medical School, and then returned to St. Louis to practise. It was his first intention to take up orthopedics, but having a natural aptitude for the electrical arts, he was soon attracted to medical roentgenology, which was then in its early stages of development.

By advancing with the science and working diligently and enthusiastically, he shortly became known as an exceedingly proficient and unusually reliable roentgenologist. He was a professor of roentgenology in the medical school of St. Louis University, and resigned later to accept the same post in Washington University. On invitation he joined the staff of The Mayo Clinic, Jan. 1, 1913, as head of the Section on Roentgenology, and continued in that capacity until his death in 1926.

The science of roentgenology having developed within the memory of members of the present generation, its true relationship to the control of chronic diseases which afflict members of the human race cannot easily be appraised, but it is a safe prediction that any present evaluation of the place of roentgenology in the science of medicine will, in retrospect, be found to be an under-estimation. Roentgenology has not only enabled the clinician to confirm his observations, but, more important, has given him information that is obtainable in no other way. It has made the impossible possible.

The application of the science has made it an essential factor in diagnosis in a greater number and wider variety of chronic diseases than is true of any other method, and this application is steadily becoming more comprehensive. Since the whole structure of therapeutics rests on accuracy of diagnosis, the importance of this fact cannot be exaggerated. The future medical historian, in judging the great benefactions to the health and happiness of mankind, must accord to roentgenology a place with anesthesia and antiseptics.

Many of the most serious diseases, notably cancer, frequently fail to give rise to any clinical signs or symptoms in their early stages, and roentgenology frequently

¹ Read before the Radiological Society of North America at Memphis Tenn. Dec. 3, 1934.

makes recognition possible at a time when there is the most favorable situation for bringing about cure. The presence of early pulmonary tuberculosis, of symptomless cancer of the stomach, or of certain lesions of the skeletal system, can in many instances be determined only by roentgenologic examination, and if there were some method of applying it routinely, countless deaths from these diseases could be prevented. The progress of roentgenology will, therefore, lie in its further development in detecting disease before clinical signs and symptoms are manifest, and a great impetus to this would be an inexpensive, efficient, and practical roentgenologic examination for detecting in the course of periodic health examinations these early deviations from normal, the control of which is so desirable in bringing about longer and healthier life.

This tremendous capacity for good must not conceal the fact that it is in interpretation of the revelations of the roentgenogram and fluoroscope that the sound development of the science lies, and the more keen the roentgenologist, the more he will realize that the significance of his findings must be judged by an astute clinician, just as the clinician will also demand skilled roentgenologic interpretation of his findings.

In no field of medicine are these facts more applicable than in the diagnosis of lesions and abnormalities of the gastrointestinal tract, and particularly of the stomach and duodenum. Prior to the development of roentgenology, the difficulties confronting the clinician in the interpretation of symptoms directly or indirectly referable to the gastrointestinal tract were so great that it was impossible to avoid misconceptions of the incidence, nature, and course of both benign and malignant lesions in this region. The work of pioneer roentgenologists indicates that many of these viewpoints could be clarified, and in this respect roentgenology has done more than any other factor to advance and perfect our knowledge in this field.

Since Carman's work was largely directed to the development of roentgenologic interpretation of lesions of the stomach and duodenum, it seems appropriate to discuss the debt of surgery to roentgenology by briefly summarizing the present status of our knowledge of diseases of the stomach and duodenum and their management, in the hope that in such a discussion roentgenologists may find some suggestions as to further possibilities in the development of their science.

It has been during the past twenty-five years that the progress of our knowledge in respect to lesions of the stomach and duodenum has been most rapid. In the first place, pathologists took advantage of the opportunity afforded by the surgeon of studying lesions in their various stages of development, rather than being confined to study of those lesions which had terminated the life of the patient. For this reason a more satisfactory classification of such lesions, from a pathologic standpoint, can now easily be made.

Great advances also have taken place in our knowledge of the physiology of the stomach, both in health and disease, and particularly in its motor and secretory functions. The clinical manifestations of disease have been better understood because of this pathologic and physiologic background and the known character of lesions in their various stages and their effect on gastric function.

Strangely enough, not yet is as much known about the uninterrupted clinical course of benign lesions of the stomach and duodenum as is desirable, in the first place because many of these lesions do not give sufficient symptoms to be recognized, and secondly because the course of the benign lesion is usually so chronic in a large group of cases that a much longer period of observation is necessary to get a true estimate of the prognosis. The great stumbling block is the lack of knowledge as to the cause of benign lesions of the stomach and duodenum, and in the absence of any known cause, theories are numerous.

The greatest impetus to our knowledge,

however, has been the accuracy of diagnosis, since all therapeutics must depend for its success or failure primarily on this, and it is in accurate diagnosis that the difference exists between quackery and scientific medicine. Since roentgenology has made such accuracy possible, it is difficult to overestimate the direct benefits of roentgenology to humanity. And, when it is considered that as yet no direct method, such as intragastric photography or visualization by gastroscope, has equalled in any respect what can be determined indirectly by roentgenology, one's amazement grows that any such method should attain such precision. To take advantage, therefore, of this precision, I shall attempt to outline briefly what appear at the moment to be some of the more important lesions of the stomach and duodenum and their treatment.

The most common lesion of either the stomach or duodenum is ulcer, and there are certain important facts which have significance to the clinician, roentgenologist, and surgeon. The lesion is very frequently multiple, in fact, in some recent reports ulcers or scars of ulceration have been shown to be present in 100 per cent of cases. It is this multiplicity of lesions and the constant tendency for such lesions to heal which is responsible for the great variety of deformities of the duodenum seen at operation. The most constant of these is the shortening of the duodenum that can be shown in all cases in which a lesion has undergone any attempted healing. Perhaps of greater interest to the roentgenologist is the pouching that may occur on either the superior or inferior border, or on both, and which sometimes results in what appears to be a true diverticulum. The most important consideration from a clinical standpoint, perhaps, is that by far the greatest number of the extensive lesions are on the posterior wall, and it appears that these lesions are the most difficult to heal, probably because they become easily fixed to retroperitoneal tissues, namely, in the head of the pancreas. When such fixation has occurred,

healing seems almost out of the question. While inflammatory processes may occur in any situation, they are usually confined, however, to the first portion of the duodenum, and they exhibit lesions in every stage of development and healing.

One of the most interesting problems to the solution of which the roentgenologist contributes is that of duodenitis and its relationship to actual ulcer. It is, I think, commonly agreed that the inflammatory area of the duodenum may be, and probably is, the precursor of actual ulceration, so that the exact recognition of duodenitis by roentgen rays would be a very great accomplishment. The difficulty is that duodenitis is so frequently found to be associated with other lesions that management must be directed toward a multiplicity of lesions rather than toward a single inflammatory process. Just as the pathologic and physical characteristics of duodenal ulcer are variable, so the symptoms are exceedingly variable, and it is difficult in many cases to correlate these symptoms with the pathologic changes present. For the same reason treatment must be adjusted to these symptoms, so that it will vary from none at all being indicated, the lesion healing spontaneously, to removal of the inflammatory area with a substantial portion of the stomach to eliminate all known factors in the production of the lesion. Between these extremes, however, there are a number of measures designed for control. All these have the same purpose, namely, to provide as much rest as possible for the lesion and to so modify gastric function that sufficient rest will be maintained. In medical treatment this is attained by frequent feedings of a small, bland diet, with necessary alkalies, to control hyperacidity, from a surgical standpoint the same purpose is attained by various types of operations.

The roentgenologist will, with experience, find in the behavior of the stomach of the patient with duodenal ulcer certain suggestions as to what will be the most successful operation. When the patient has marked obstruction from duodenal

ulcer, impairment of motility, as shown under the fluoroscope, suggests, or at least very clearly indicates, that relief of this impairment will be all that is necessary. In this his supposition would be quite correct, because satisfactory results are obtained in cases in which there are such disturbances of function. When the stomach shows great hyperactivity, the operation of gastro-enterostomy, which is so effective when an obstruction exists, does not bring about as satisfactory results, for it is this very hyperactivity that makes possible the development of recurrent lesions. In this type of case, therefore, local operations on the outlet of the stomach are preferable, and in rare cases, when marked hemorrhage has occurred, some method of partial gastrectomy is desirable. Of these methods of partial gastrectomy, probably restoration of gastric continuity by uniting the stomach and duodenum is preferable to uniting the stomach and jejunum. The results of treatment of duodenal ulcer show it to be a disease that can be controlled, in from 85 to 90 per cent of the cases, by the co-ordinated efforts of the roentgenologist, physician, and surgeon.

Duodenal diverticulum is an example of a condition that can be detected only by the roentgenologist. It is true that only after it is found will a clinician assume that there are symptoms connected with the diverticulum, but these symptoms are so vague that I have never known a diagnosis to be made on clinical examination alone. The incidence of true diverticulum is about 2 per cent. Foreign bodies and benign tumors also can be detected only by roentgenologic examination.

Cancer of the stomach is a disease which may occur at any age, and various pathologic forms may involve any part of the stomach and vary greatly in virulence and in the symptoms produced. With all the discussion as to how more could be accomplished in attacking this serious problem, there is one fact that is more important than all others. That fact is that the hope of the patient with cancer of the

stomach lies in the roentgenologist. This is for the reason that although in its early stages cancer of the stomach seldom gives rise to definite symptoms, usually there are sufficient signs and circumstances to arouse the suspicions of the discerning physician, and it is hoped that in the future the patient will be sufficiently educated to ask for the only method by which an early diagnosis can be made, namely, competent roentgenologic examination. The roentgenologist, therefore, probably has his greatest responsibility in this disease for the reason that it is in these early cases that removal is so much more likely to be followed by cure. There are certain aspects of cancer of the stomach which I think are particularly important. First, that while it is true that roentgen rays offer by far the best method of examination, it is also true that even in experienced hands a fairly advanced lesion may be overlooked. Therefore, I believe that when the clinician suspects cancer of the stomach and a single roentgenologic examination does not substantiate this opinion, a second examination or repeated examinations should by all means be made at an interval of a few days.

Again, with advanced carcinoma, the roentgenologist should co-operate with the clinician and surgeon in deciding whether exploration is worth while because of involvement of the upper part of the lesser curvature, since it is possible to remove the entire stomach and it has been shown that a patient can live in comfort with an anastomosis between the esophagus and jejunum or the esophagus and duodenum. I believe, therefore, that a patient with cancer of the stomach should never be dismissed as hopeless until there is a direct discussion of the whole situation with the roentgenologist. In the treatment of cancer of the stomach, curability, under the circumstances, should always be stressed, and when the disease is confined to the stomach, complete removal of the lesion at operation results in patients being alive and well at the end of three years in approximately 50 per cent of the cases. There are a great number of procedures for

dealing with gastric cancer, all being based on general principles, namely, thorough removal of the growth and restoration of continuity so that the anastomosis will function well

Gastric ulcer is much less common than gastric cancer. Its well known predilection for the lesser curve at the angle is fortunate because this is a situation in which the lesion is readily accessible to surgical attack. It has been shown that those lesions on the greater curve are more likely to be malignant than benign, and for that reason they should perhaps be distinguished from those on the lesser curve. Lesions high on the lesser curve are perhaps of a less serious nature than those between the incisura and pylorus. There is still a good deal of confusion about the pathology of ulcerated lesions of the stomach, and I think this is largely unnecessary because as yet there is no way of determining by any gross methods of examination what the microscopic picture of a lesion is, however, more important contributory evidence has been brought by roentgen rays to differentiate malignant and benign lesions. Nevertheless I think one of the most important points in this respect was made by Carman when he adopted the practice of frequently referring to ulcers of the stomach as "lesions" rather than as "ulcers."

Caution should also be used in drawing deductions while observing the course of gastric ulcer by means of roentgenologic examination. It is well known now that the malignant ulcer may respond to intensive medical management not only in relief of symptoms, but also in decrease in size of the lesion, yet we have seen a number of cases in which the result of medical management has cost the patient his life, in that it seemed to prove the lesion was benign. The treatment of gastric ulcer should also take into consideration these possibilities, and in those cases in which surgery seems indicated the most important fact is that if the competent roentgenologist has identified the lesion in the stomach, however small, the surgeon is probably wrong if he fails to find it. I have been amazed on a

number of occasions to find, after great difficulty, of course, a lesion awkwardly situated on the posterior wall and of such small size that it could be entirely overlooked had not the roentgenologist stated that it had been seen.

Gastritis is probably the most common of all conditions of the stomach, since it always accompanies in some degree any lesion whether malignant or benign. As yet in this country there has been no tendency to direct any surgical measures toward gastritis *per se*, but I believe one should keep an open mind as to the relation between gastritis and chronic lesions of the stomach, and we will probably again be indebted to roentgenology for establishing more accurate methods of determining the presence and degree of gastritis.

Benign tumors of the stomach are either symptomless or associated with secondary anemia, the source of which would entirely be unsuspected were it not for the visualization by roentgen rays. Since these tumors are often the cause of very serious injury to the blood, and since they can be readily removed by operation, with complete cure of the patient, roentgen rays can again be given the entire credit for the successful management of the condition. Again, with foreign bodies, and with gastric syphilis, the establishment of the diagnosis depends to a large extent on roentgenologic examination.

It has recently been shown that herniation of the stomach is a much more common condition than previously was thought, and while the symptoms of herniation through the esophageal opening have been studied by Harrington, and certain significant points have been established, again the only method of determining whether such herniation exists is by means of the fluoroscope. To emphasize the contribution in this field, one might say that during the past year 41 cases of herniation were identified as against approximately five cases twelve years ago.

The pylorus offers some interesting problems to roentgenology. By far the

most common secondary effect of intra-gastric and extragastric disease is pylorospasm, and there has been much speculation not only as to its significance as a reflex condition, but, and probably more important, as to its relationship to the development of intragastric disease, particularly peptic ulcer. I believe it is generally agreed that persistent and recurrent pylorospasm in some way disturbs gastric function, to an extent that inflammatory processes are not only more prone to develop, but are less likely to heal when marked pylorospasm is present. The detection, therefore, of pylorospasm, and of the various degrees of pylorospasm, would be an important contribution to our knowledge of the etiologic factors concerning peptic ulcer.

Another condition which has given rise to a good deal of interest and which is of much clinical importance, is hypertrophy of the pyloric muscle. We have seen some extraordinary examples of this condition among adults, in which hypertrophy was demonstrated by roentgenologic examination and was present beyond any question at operation, and from which the patients were completely relieved of symptoms (usually somewhat suggestive of ulcer) by permanent ablation of the muscle. The pylorus, and its effect on gastric function and its relationship to chronic disease, is, I believe, worthy of considerable further study, in which the roentgenologist will again play a prominent part.

The most difficult problems which present themselves to the clinician, roentgenologist, and surgeon are involved in those cases in which patients have not been relieved by operation of symptoms due to benign lesions, or in which secondary ulceration has developed. The clinician and surgeon are confused largely because the rule is that good results are obtained when operation is clearly indicated and properly performed. In cases of such secondary ulceration one is constantly dealing, therefore, with the exception rather than the rule, and to the problem of the lesion itself is added the necessity of evaluating the

physiologic results of the operation. In a similar way the roentgenologist finds that in examinations of the stomach in which there is secondary ulceration interpretation is difficult. This is to a large extent the result of the fact that the correlation between the roentgenologic findings and symptoms in cases in which various types of operations have been performed is not as definite as in cases in which patients were not operated on, and one could very properly emphasize the danger of unwarranted deductions being made from what appeared to be deviations from normal in the roentgenologic findings. I have repeatedly seen patients, who had attained perfect results from operation and who had normal digestion, become disturbed because the roentgenologic report showed dilated intestinal loops or some deviation from normal in the emptying of the stomach.

It is just as true in the stomach and intestines as in the other parts of the body that, if normal function is present, form, position, and physical signs are not of much significance. Yet with all these difficulties of interpretation it is still true that roentgen rays offer the greatest help in these cases of secondary ulceration, and it is also true that the greatest co-operation between clinician and roentgenologist is necessary in such cases. The determination of whether the primary lesion has been reactivated or whether a new lesion has developed is of the utmost importance in the management of the patient. In those cases in which a short-circuiting operation has been done for an inflammatory process in the duodenum, and in which there is recurrence of symptoms, the surgeon is particularly interested in how the pylorus is functioning. It may be assumed in such cases that the inflammatory process in the duodenum, if the gastro-enteric stoma has functioned well, has healed, but since healing is always associated with some deformity, unwarranted deductions must not be made because such deformity is demonstrated by roentgen rays, and it is known that even considerable deformity in

the duodenum may be entirely consistent with good digestion

The value of roentgen rays in this field is such that the experienced roentgenologist frequently is able to suggest to the surgeon what type of operation would probably be best in the case in which further surgery seems advisable. This group of cases, I believe, is the high mark in illustrating the place roentgen rays have in the diagnosis of lesions of the stomach and duodenum.

The debt to those who have developed this phase of science cannot be measured, and the Radiological Society of North America has added to its prestige by choosing to honor in this permanent way one of its members, Russell D. Carman, who will always be identified with that group of investigators who recognized the possibilities of roentgenology and who, by their industry, vision, and imagination, have carried it to such great heights. Carman possessed the true character of the pioneer. He was a prodigious worker, enthusiastic yet cautious, he was courageous in the face of difficulties and disappointments, determined to know the truth, and willing to sacrifice everything which might interfere with this purpose. He made it a practice to see at operation that which he studied by fluoroscope and roentgenogram, and I shall never forget the eagerness with which he viewed the field of operation to learn whether his diagnosis could or could not be confirmed. I never knew him, when he had made a positive diagnosis in an obscure case, try to persuade himself that

a lesion was present which could not be seen by others, in fact, it often appeared that he seemed gratified if his diagnosis was not substantiated, for he realized that with any method which held such great potentialities for accuracy, its true value would be more quickly determined by encountering mistakes in diagnosis.

Carman's great contributions were in the field of gastro-intestinal diagnosis, and are recorded in his classic monograph. He was quick, however, to sense the limitations of roentgenology, and when the medical world became aware of the extraordinary accuracy of roentgenologic diagnosis of lesions of the gastro-intestinal tract, he was one of the first to point out that in certain cases roentgenology could determine only that a lesion was present, and that any attempt to specify its pathologic character might mislead the clinician and be responsible for unsound advice being given the patient.

On the occasion of Carman's untimely death, his life-long friend and associate, Albert Miller, wrote "The world of the x-ray lost a master workman. For a time it will grieve that he is dead. For a longer time it will rejoice that he lived."

I feel greatly honored that I should be permitted the opportunity of being here and of congratulating the Society on the establishment of the Carman Lectureship, which will bring to all subsequent meetings of the Society the spirit of one who loved his profession and who exemplified the highest ideals.

INFLAMMATION OF THE DESCENDING PORTION OF THE DUODENUM

PRELIMINARY REPORT

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IT IS the purpose of the present report to emphasize the fact that duodenal inflammatory lesions occur distal to the duodenal bulb, and particularly in the portion between the knee and the papilla major. This is of importance because the clinical symptomatology is much like that of duodenal ulcer, but the duodenal bulb shows little or no change roentgenologically and a lesion in the descending portion of the duodenum is either not sought or difficult of demonstration.

Naturally, any study of the descending duodenum is based upon very limited pathologic material since few of these lesions are removed surgically. The present study includes eight cases in which the diagnosis of an inflammatory lesion of the descending portion of the duodenum was made roentgenologically. Two were operated on, but the information obtained was not very satisfactory and the conclusions arrived at in these cases must, therefore, be evaluated accordingly. In general, the cases could be grouped roentgenologically as follows:

- (1) Stenosis and irritability of the descending portion alone
- (2) Stenosis with the demonstration of an ulcer crater within the stenotic lesion
- (3) Stenotic lesion in association with ulcer of the duodenal bulb
- (4) Stenotic lesion in association with gastric ulcer

Outstanding features were relatively slight to marked narrowing of the lumen of the duodenum between the upper knee and the papilla major, marked irritability, irregularity in outline or unusual smoothness, and a marked disturbance in the longitudinal mucosal folds so that they either disappeared or were irregular in their distribu-

tion as demonstrated by compression technique. In one case, what was interpreted as an ulcer crater, was demonstrated at one observation but not at a later period. The stenosis was usually not obstructive, suggesting that spasm played a considerable rôle in the roentgen appearance.

In all of our cases in which a Graham test was made, the gall bladder filled and emptied normally and no calculi were demonstrated, there was no history of jaundice nor biliary colic in any. This would make a diseased gall bladder unlikely as the source of adhesions. Differentiation of duodenitis from periduodenitis, essential or of gall-bladder origin, is difficult. In our experience, if adhesions are sufficient to produce stenosis, obstruction at that point is produced, with dilatation of the bowel proximally. Any irritability present under these circumstances is not constant and is probably due to spasm. It is stated by some, however, that adhesions may produce marked deformity of the duodenal outline and a more or less uniform narrowing of the lumen, the roentgen appearance of which is much like that of intrinsic inflammatory disease. This matter is further discussed below.

The clinical and roentgen differentiations of duodenitis from malignancy involving the descending portion of the duodenum, primary or secondary, may be very difficult. The duodenum is rarely involved in carcinoma of adjacent structures. Primary duodenal neoplasm is extremely rare. The chronicity of the disease, the absence of jaundice and of marked loss of weight, clinically suggest an inflammatory process. Roentgenologically, with tumor, there may be a widened duodenal curve. If there is stenosis, the lumen is more irregular, the contour appears worm-eaten, and the lon-

gitudinal mucosal folds are much more distorted than in inflammatory disease

Differentiation of ulcer of the descending portion from diverticulum may be difficult. The latter usually appears as a large pocket of barium, without stenosis, spastic or organic, and without irritability. The mucosal folds are not disturbed. The papilla major usually presents as a small filling defect on the inner side of the duodenal curve. Sometimes, there is a retraction of the papilla so that a small pouch of barium appears at this site, the differentiation is suggested by the location, its features being much like those of a small diverticulum. Pseudo-diverticulum, secondary to ulcer of the bulb, rarely leads to any difficulty in differential diagnosis.

Clinically, inflammation of the descending duodenum is much like duodenal ulcer and may be indistinguishable from it. However, analysis of our cases offers features which may suggest the differentiation in a given case. The pain, so characteristically regular in ulcer, in this condition is apt to be more irregular in time interval and intensity. Nocturnal pain, waking the patient from a sound sleep, has been described, and appears several times in our cases. Vomiting is not a common feature of duodenal ulcer, but attacks of nausea and vomiting are relatively frequent in inflammations of the descending portion; the patient is relatively well between attacks. Response to the Sippy diet is not as rapid nor as complete as might be expected. Judging from the literature, hemorrhage, on the other hand, although not prominent in our series, is a frequent finding, usually in the form of melena. The disease is extremely chronic but periodicity is not a prominent feature, it does not, however, lead to marked loss of weight. Hyperacidity is usually marked and prolonged but not necessarily so. When the disease occurs in association with a peptic ulcer, the symptoms of the latter are usually exaggerated.

The clinical symptomatology, then, suggests peptic ulcer. It is extremely important, therefore, in all such cases, to

include a careful study of the descending duodenum whether a peptic ulcer is found or not. This remark must also apply to the exploring surgeon, since the pathologic changes to be observed are mucosal and submucosal, and opening of the duodenum cannot be expected to reveal an ulcer. It is proper to emphasize the necessity for routine observation of the descending duodenum roentgenologically in all cases, in order to be thoroughly familiar with the normal anatomy and variations.

Case 1 (364,454) Male, aged 37 years, was first seen on April 4, 1934, at which time he complained of nausea and vomiting two hours after meals. These symptoms accompanied a rather severe epigastric discomfort and had lasted for six weeks. There was no loss of weight. Physical examination showed no definite abnormalities. Hemoglobin was 86 per cent. Blood count showed no significant changes. Blood Wassermann was negative. Gastric content showed total acid, 80, free acid, 73. Stools, guaiac negative.

With bed-rest and a modified Sippy diet, there was a cessation of the nausea but the vomiting continued. Roentgen examination of the gastro-intestinal tract at this time showed (Fig 1) a narrowing of the duodenum from the knee distally to about the region of the papilla. Projecting from the mid-portion of this region a patch of barium was seen which was interpreted as an ulcer crater.

After leaving the hospital, the symptoms recurred and have persisted. On Jan 22, 1935, the involved portion of the duodenum was found roentgenologically to be even more narrowed, but the ulcer crater was no longer demonstrated. Graham test showed a normal filling and emptying of the gall bladder. No stones were demonstrated.

Case 2 (375,169) Male, aged 25 years, who complained of intermittent attacks of epigastric pain, radiating to the left shoulder, which were relieved by vomiting. The pain occurred two to three hours after meals. It had appeared in attacks for about seven years. Postural relief was a rather prominent feature. There was no

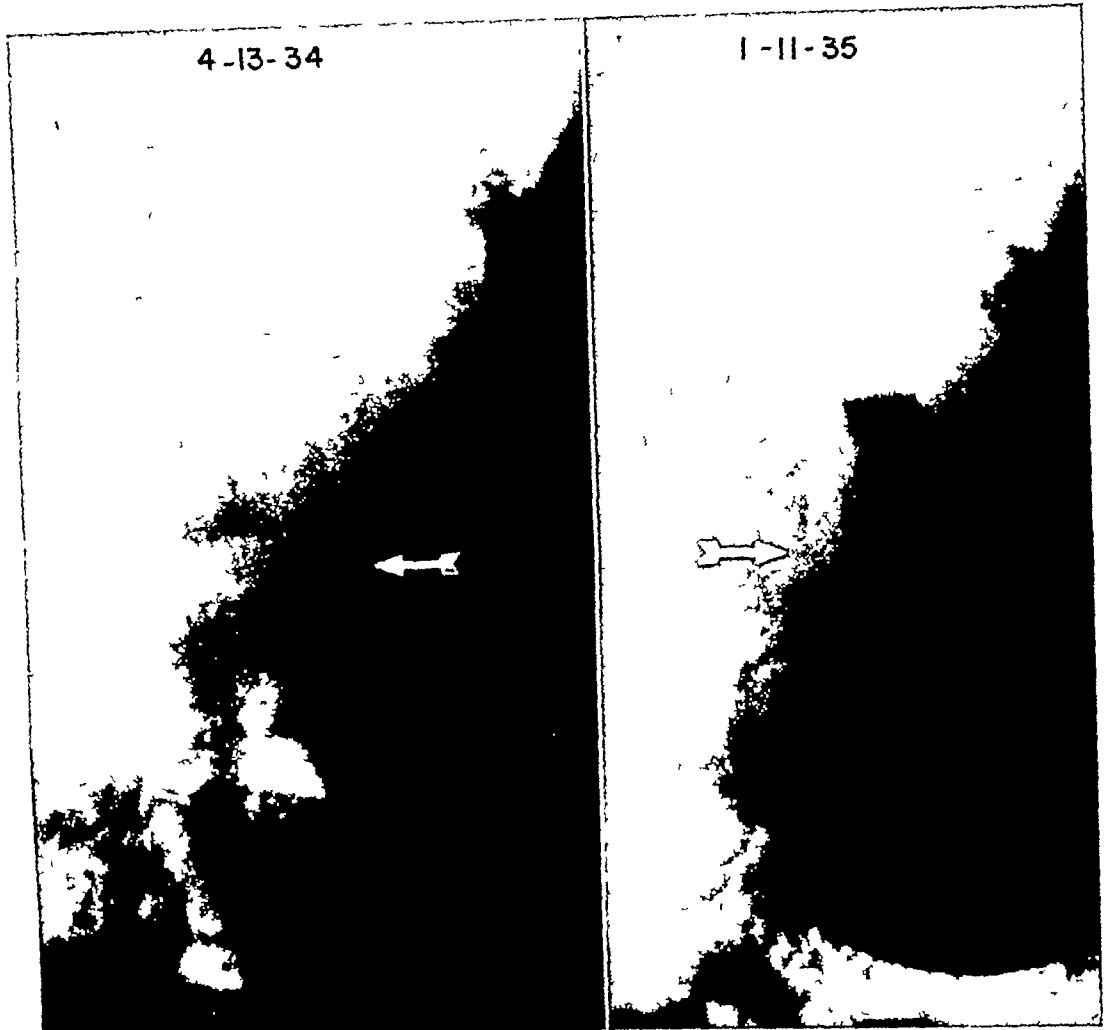


Fig 1 Case 1 On April 13, 1934, there was a narrowing of the descending portion of the duodenum. Arrow points to a patch of barium thought to be an ulcer crater. On Jan 11, 1935 the stenosis is more marked, and there is no demonstrable patch of barium.

loss of weight. Physical examination revealed moderate epigastric tenderness. Hemoglobin was 99 per cent. Blood count was essentially negative. Stools, guaiac negative. Gastric contents showed free acid 60, total acid 68.

The patient had been examined roentgenologically several times elsewhere during his illness and was reported variously as showing no lesion, a duodenal ulcer, and, lastly, an inflammatory lesion of the second portion of the duodenum. Graham test was negative, both in 1928 and in 1935. Roentgen examination, in 1935, showed the stomach and duodenal bulb to be normal in

outline. The duodenum from the knee to about the region of the papilla major was narrowed, the degree of constriction varied, suggesting the presence of marked spasm and irritability (Fig 2). There was no tenderness and no delay in gastric emptying. The patient had not responded to an ambulatory Sippy diet, but with rest in bed, in addition, he showed remarkable improvement.

Case 3 (367,593) Male, aged 30 years, was first seen in 1924, at which time, in addition to evidences of central nervous system syphilis, and epilepsy, he complained of epigastric pain more marked on the left

side, with tenderness and a burning sensation in this region. Vomiting within a half-hour after meals was a promi-

constriction of the descending portion of the duodenum, its contour was irregular, and the mucosal folds were distorted. Simi-



Fig 2 Case 2 Marked narrowing of the descending duodenum from the knee to the region of the papilla

nent feature. The patient was badly constipated. Gastro-intestinal series was reported negative. In 1924, he was explored and the report states that there were broad adhesions to the appendix, which was thickened, adhesions from the gall bladder to the duodenum, but a normal gall bladder, and an area of infiltration in the duodenum which surgically appeared fairly close to the pylorus. An appendectomy was performed; there was no relief of symptoms. In 1926, the patient was again explored, this time with negative findings. In 1935, a gastro-intestinal series showed a

lar findings have been noted on several occasions during the previous years and were interpreted as being due to adhesions.

Case 4 (35-1536) Male, aged 32 years. Three weeks before admission to the Out-patient Department, the patient experienced a sudden pain in the epigastrium which persisted up to admission, and came on chiefly one hour after meals. The pain radiated along the subcostal margin and woke the patient regularly at night. There was no vomiting and no melena. Stool, guaiac, negative. Gastric contents showed a total acid 70, free acid 60.

Roentgen examination of the gastro-intestinal tract showed no abnormality in the stomach. The duodenal bulb was con-

three years. There was anorexia and loss of about fifteen pounds.

The report of the roentgen examination

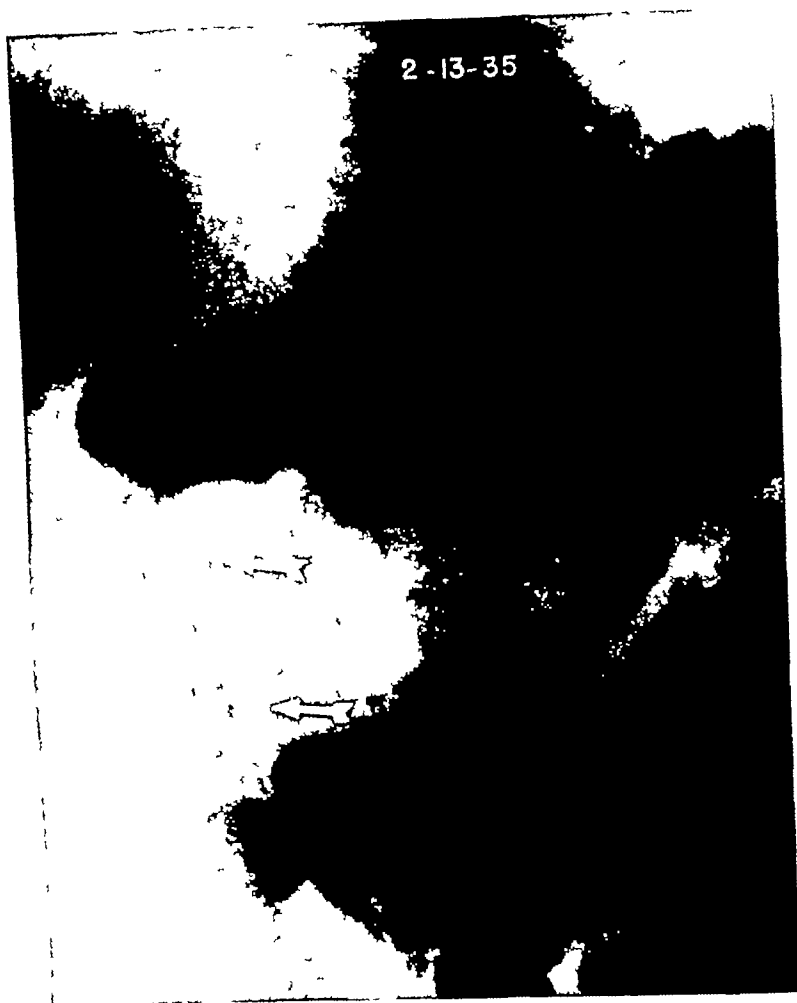


Fig 3 Case 3 Marked irritability of the descending duodenum, distortion of the longitudinal mucosal folds, with irregularity in outline and moderate stenosis

stantly irregular fluoroscopically and on the films. The duodenum down to the papilla was also irregular and spastic; there was moderate stenosis. The patient responded well to a Sippy diet.

Case 5 (377,811) Female, aged 32 years, was first admitted to the hospital in 1932, with a history of frequent vomiting immediately after meals, and attacks of severe, sharp epigastric pain, radiating to the back. The attacks of pain were said to have occurred about ten times a year for

of the gastro-intestinal tract at that time. States that no abnormalities were found. There was a small gastric residue six hours after the meal. An exploratory laparotomy was performed at that time. The proximal half of the duodenum was found to be dilated. The reason was not determined, but a duodeno-jejunostomy was performed. The chart states that ten weeks after operation there was a recurrence of the epigastric pain, with difficulty in swallowing, belching and sour eructations.

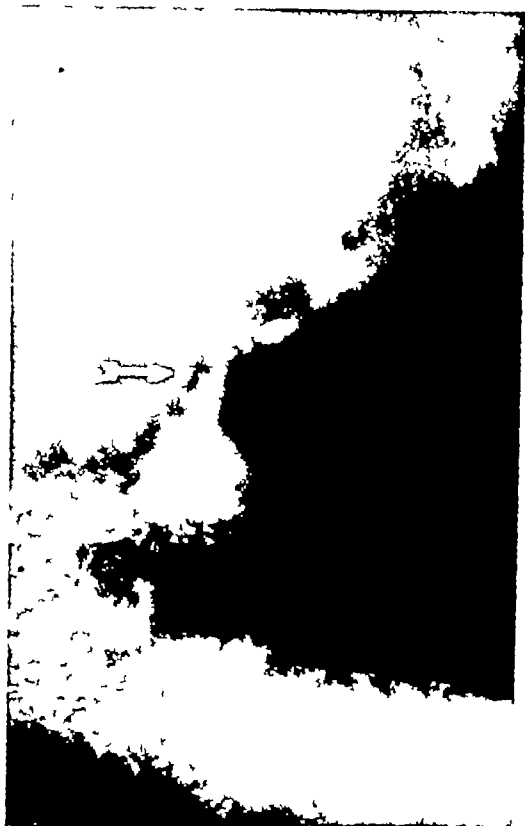


Fig 4 Case 4 Irregular duodenal bulb. Marked narrowing and irritability of descending portion of the duodenum.

In 1923, a constriction of the second and third portions of the duodenum was noted roentgenologically, with dilatation proximally. There was a 30 per cent gastric residue six hours after the meal. The case was clinically considered to be one of *asthema universalis congenita*, with atony of the stomach.

In 1932, there was evidence suggesting a gastric ulcer at the re-entrant angle, which was demonstrated more definitely several times in 1934. In 1935, careful roentgen examination failed to show evidence of the gastric ulcer seen previously. There was, however, a slight constriction of the descending portion of the duodenum, with irritability and spasm. There was a moderate distortion of the mucosal folds. The duodeno-jejunostomy stoma functioned well. Gastric content showed total acid 40, free acid 25.

The patient is also a psychoneurotic, in view of which it is extremely difficult to evaluate the rôle of the duodenal lesion and of the previously demonstrated gastric ulcer in her symptoms.

Case 6 (CS 11/27/34) Male, aged 37 years, complained for four months of cramp-like pain localized to the epigastrium. This would be relieved by the ingestion of food, but would recur three or four hours later. Six weeks after the first visit he was put on a modified Sippy diet which relieved his pain, but the latter recurred if there were dietary indiscretions. There was a loss of 14 pounds in five months. Physical examination was essentially negative. Hemoglobin was 100 per cent. Blood count was essentially negative. Blood Kahn test was negative. Urine was negative. Stool examination after a free meat diet for three days was positive for occult blood. A Rehfuß test meal showed marked hyperacidity. A gastro-intestinal series showed a bilobed filling defect in the duodenum, just beyond the knee, in the center of which there was a pin-point collection of barium. There was marked irritability in this region. The duodenal bulb was apparently normal. The Graham test showed no abnormality in the gall bladder. The clinical diagnosis was duodenal ulcer.

Case 7 Male, aged 44 years, who two and a half years before the present examination, was awakened at 3 A.M. by a burning, rumbling sensation in the abdomen, which was relieved after ten minutes by gaseous eructations. This was repeated several times during the remainder of the night, awakening him from sleep each time. Since then he has noted epigastric oppression a half-hour after meals, relieved by gaseous eructations. One year before examination mucus was noted in the stools, but there was no evidence of melena. There has been a weight loss of 40 pounds in two and a half years. Physical examination was essentially negative. Hemoglobin was 80 per cent. Blood count, Blood Kahn test, and urine were negative. The basal metabolic rate was minus 14 per cent. The Rehfuß

test meal showed a moderate hyperacidity. Roentgen examination revealed an irregularity of the second portion of the duodenum, with slight narrowing and irritability. The case was clinically thought to be one of ulcer of the second portion of the duodenum. The possibility of a carcinoma of the pancreas could not be excluded.

Case 8 Male, aged 50 years, who complained for many years of attacks of epigastric pain. Recently there have been attacks of vomiting but essentially without pain. These episodes have been of two or three days' duration, and are apparently precipitated by dietary indiscretions. Between the attacks the patient is relatively well. There is no loss of weight. The maintenance of a modified Sippy diet did not prevent recurrence. The patient has been examined several times during these years and at all observations a marked deformity of the duodenal bulb has been observed. In addition, both in 1928 and at the present time, there is definitely demonstrated a narrowing of the descending portion of the duodenum, with spasm and irritability.

During recent years, there has been increasing interest in a subject which has been described under various titles, but particularly that of duodenitis. Judd and Nagel define this condition as a chronic inflammation of the duodenum without caloused ulcers. They differentiate duodenal ulcer and duodenitis, pathologically, as follows. In duodenal ulcer, the wall of the bowel is indurated and, if there is a slow perforation of the ulcer, tumor may form as the result of the defensive reaction of the surrounding tissues. When the intestine is opened, the ulcer crater is seen. In duodenitis, or submucous ulcer, there is congestion and stippling of the serosa, with little or no induration. There is no lesion of the mucosa, or, at most, small superficial abrasions. There is often a tendency to circular constriction of the bowel, but there is usually a question as to whether it is due to spasm or true narrowing.

Balfour notes. Inflammatory lesions of the duodenum are practically confined to

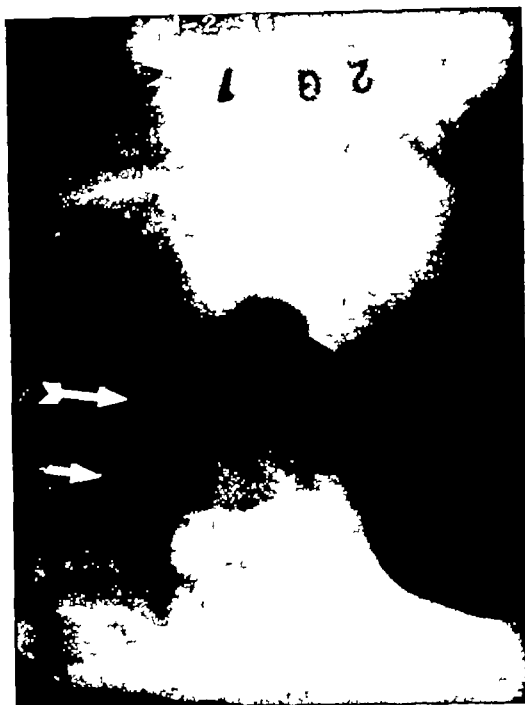


Fig 5 Case 6 Bilobed filling defect in descending duodenum with small patch of barium between the lobes

the first two centimeters beyond the pylorus. Lesions seldom extend distally into the first portion of the duodenum (*i e*, distal to the bulb). Still more rarely do lesions involve the ampulla of Vater, and inflammatory processes beyond this point are almost unknown."

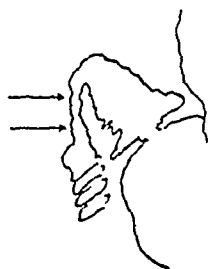
It is difficult to evaluate the literature on duodenitis since the term is used indiscriminately, either as defined above (Judd and Nagel, Kellogg and Kellogg), or in the more specific sense of an extra-bulbar inflammation of the duodenum (Robinson). The pathologic changes of duodenitis, whether limited to the bulb, to the pars descendens, or appearing in both, are apparently the same. Kellogg and Kellogg divided the general condition into three forms.

(1) A mild form, with slight edema and hyperemia, usually on the anterior surface just beyond the pylorus. There is a faint stippling when the serosa is rubbed. There is no deformity of the duodenum but there may be pylorospasm.

(2) A more advanced form in which the duodenum is red, hyperemic, and edematous, with marked stippling of the serosa

(3) The duodenum is narrowed over a considerable area. There may be deform-

Ulcer," a group of cases with ulcer distal to the bulb. He states that most instances of this type of ulcer occur in the pars superior, but some are found in the pars descendens, where there is a constant peripheral filling



CASE V



CASE VII



CASE DESCRIBED AS
ESSENTIAL PERIDUODENITIS
(DUVAL, ROUX & BECLERE)



CASE VIII 1928



CASE VIII 1935

Fig 6

ity of the duodenum but no stellate scars, irregular contractions, or punched-out lesions. There is a tendency to circular constriction of the bowel, but whether due to spasm or true narrowing is difficult to determine. All stages of superficial ulceration may be seen, from tiny abrasions to fissures, and ulcers of considerable size.

On the other hand, Robinson describes, under the title "Extrabulbar or Duodenal

defect rather than an ulcer crater. The pathology, he states, is like that of the usual peptic ulcer. The lesions in the pars superior are of the calloused and stenosing types. They are deep chronic craters, thick ulcer beds, and show marked deformity, usually on the upper side of the duodenal arch. Those in the pars descendens are usually on the outer and posterior portion of the arch. There is a tend-

ency to rapid healing, as in gastric ulcer Robinson states that the process of repair is so rapid, especially in ulcers of the greater curvature, that, instead of a distinct niche at the time of the examination, a definite filling defect is found, due to cicatricial contraction of the fibrous connective tissue in the ulcer bed, with obliteration of the adjacent intervalvular space. Yet he did not observe stenosis of the lumen.

De Abreu has recently offered an excellent review of the subject of "Absteigende Zwölffingerdarm-Entzündung." He states that inflammation of the descending portion of the duodenum between the papilla major and the upper knee is not unusual, and is very often found in association with gastric ulcer, but more particularly duodenal ulcer. There are marked changes in the duodenal wall, thickening of the mucosa and the loose areolar submucosa, due to edema and inflammatory infiltration. There is a marked increase in the connective tissue, with hyperplasia of the cellular elements and atrophy of the muscularis. As a result, the normal irregularities in the mucosa, the hills and valleys, are either accentuated and appear stiff, or become more or less smooth. De Abreu describes three forms: the stenosing, hypertrophic, and fibrous. In the stenosing form, there is a narrowing of the duodenum due to shrinkage of the connective tissue. The loss in elasticity also contributes, since the inflamed duodenum does not dilate during the passage of food or barium. The stenosing type is often associated with peptic ulcer or chronic inflammation of the stomach or pylorus. In the fibrous form, the descending duodenum is changed into a more or less thick tube with a smooth surface. The hypertrophic form is diagnosed with difficulty, pathologically, it corresponds to hypertrophic gastritis.

The contributions of Duval, Roux, and Bédère indicate, however, that the diagnosis of duodenitis cannot be made on clinical and roentgenologic grounds alone. They describe a condition of periduodenitis in association with gall-bladder disease and particularly cholelithiasis, with adhesions

to the gall bladder and other surrounding structures. They also describe similar adhesions without any gall-bladder disease. They state "This deforming periduodenitis is always stenosing in character although to a variable degree."

The stomach usually empties itself in normal time. One of their cases is described as one of periduodenitis, with cholelithiasis and cholecystitis. Roentgen examination showed "a narrowing of the second portion with irregularity of the bulb, cap, and supra-mesocolic segment. The duodenum resumed normal caliber below. There was a closure of the genu superius." This case was operated upon, and dense adhesions with pericholecystoduodenitis were found. The similarity in the roentgen appearance to our Case 1 unquestionably introduces doubt into the diagnosis we have made. It must be realized, however, that the condition of the duodenum is difficult to establish by exploratory operation, especially if intrinsic inflammatory disease is not kept constantly in mind as a possibility. The matter can be definitely investigated only by microscopic examination of fresh pathologic material.

In regard to the clinical symptomatology of our cases, the review made by Sensenich is of interest. He summarizes the observations of Carlson, Wheelon, Ivy, Kelton, and others, and concludes that the reaction to experimental duodenal irritation in man is characterized by nausea and vomiting, produced more readily than with gastric irritation. There is also pain along the duodenum, corresponding to the point of irritation, which may be reflected under the liver. Headache, which may be severe, dizziness, faintness, chilliness, and pallor are also described.

It is not within the realm of this report to consider at length the question of etiology or pathogenesis. The rôle of gastritis and duodenitis in peptic ulcer is still a moot point in pathology. The work of Konjetzny and others suggests that duodenitis is the precursor of duodenal ulcer, the former does not necessarily go over into the phase of duodenal ulcer. Smith and Tom,

on the other hand, call attention to the fact that Brunner's glands are seen almost exclusively proximal to the papilla major, and suggest that their friability and perhaps their selective excretion of certain toxins (e g , tobacco) may be of importance. Murray suggests that the hyperacidity may be explained by a pathologic irritation of Brunner's glands and excessive secretion of gastric hormone as well as entero-kinase, erepsin, and other enzymes. It is important to remember that "between the pylorus and the duodenal papilla, the gut presents characteristics which serve to distinguish it almost as a separate organ. It has a distinct embryologic origin, being derived from the foregut, whereas the rest of the duodenum belongs to the mid-gut. It has a blood supply through the artery of the foregut, the celiac axis, and not through the artery of the mid-gut, the superior mesenteric, which supplies the rest of the duodenum. It has no valvulae conniventes, and possesses special glands which are met only here, the Brunnerian glands."

COMMENT

The cases described are presented because of their clinical and roentgenologic characteristics. These we have interpreted as indicating duodenitis, with or without an associated peptic ulcer. It is admitted that, in the absence of pathologic proof, the findings might be ascribed to a so-called essential periduodenitis. It is hoped that the preliminary presentation of this subject will lead to further interest and more definite information.

CONCLUSIONS

1. A brief review of the literature concerning inflammation of the descending portion of the duodenum is offered, and its relations to duodenitis and peptic ulcer are studied.

2. The roentgen characteristics are slight to marked stenosis of the bowel between the upper knee and the papilla ma-

jor, irritability, irregularity or abnormal smoothness of outline, and disturbance or absence of the normal longitudinal mucosal folds. In some cases, an ulcer crater is seen. There is no organic obstruction. There may be an associated peptic ulcer.

3. The clinical symptoms of peptic ulcer are obtained but are exaggerated often. There is stress on nocturnal pain, nausea and vomiting in attacks, and poor response to a Sippy régime. Hyperacidity is a fairly prominent feature.

4. An appeal for careful study of the descending portion of the duodenum is made, particularly in routine cases, to determine the normal, and in cases with a suggestive history of ulcer, in which a lesion is not demonstrated in the stomach or duodenal bulb.

5. The diagnosis of inflammatory disease of the descending portion of the duodenum rather than essential periduodenitis, in these cases, appears to be the more satisfactory.

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THE TREATMENT OF EPITHELIOMA INVOLVING CARTILAGE USING 220 K V P AND HEAVY FILTRATION¹

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THE treatment of epitheliomas involving cartilage or bone, or recurrent epitheliomas that have been previously irradiated, has long been a difficult and usually an unsolved problem. A cancericidal dose of roentgen rays on such lesions with the usual method of lightly filtered or unfiltered rays has, if the lesion was exten-

Meeting of the American Radium Society, in 1932 Taussig (1) stated "It has been found that in instances in which cartilage or bone is involved, irradiation in effective dosage is apt to produce painful and intractable reaction. This fact makes it inadvisable to irradiate growths of the ear or of the ala nasi."



Fig 1 Case 1 Before treatment cartilage is exposed



Fig 2 Case 1 Method of treatment using 25 cm cone



Fig 3 Case 1 Height of reaction 11 days after treatment

sive, produced trophic ulcers with cancer elements still present in the base. In cases in which the treatment has been successful so far as the malignant disease was concerned, the remaining ulceration with its chronicity and attending pain has not infrequently been of such a nature as to nullify the good accomplished.

To illustrate this point let us review some opinions expressed at a Symposium on Cancer of the Skin at the Seventeenth Annual

At the same meeting, Cutler (2) stated "The treatment of cancer of the skin, which has been previously irradiated but uncontrolled, constitutes a serious and difficult phase of treatment of skin cancer. Some leading radiotherapeutic clinics refuse to undertake radiation treatment of recurrent carcinoma following previous inadequate radiation therapy."

Electrothermic surgery has in many clinics supplanted sharp dissection. However, in large lesions it has the disadvantage of extensive scarring, which often necessitates plastic surgery.

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting at Memphis Tenn Dec 3-7, 1934

Surgical excision has, for the most part, been unsatisfactory. Were this not so, there would be no occasion for an attempt at developing other methods of treatment.

Heavily filtered radium element (1 or 2 mm platinum) as advocated by Pfahler and others represents a distinct advance in the treatment of this type of lesion. However, its use has been restricted to a very few clinics, which are proportionately insignificant when compared to the vast numbers of persons suffering from extensive superficial cancers.

For several years we have used various technics in the roentgen-ray treatment of extensive superficial malignant lesions, and because of the uniformly good results we believe that heavily filtered roentgen rays at voltages at or above 200 K V P represent a distinct advance in superficial cancer therapy.

TECHNIC

220 K V P 20 ma 25 cm distance
2 mm Cu and 1 mm Al filter half layer value 2.06 mm
Cu 63 r per minute^{*}

or
Thoræus filter half layer value 2.00 mm Cu 76 r per minute

Area	Daily dose	Total dose	Total time
1 × 1 cm to 3 × 3 cm	350 r	6,000 r	19 days
3 × 3 cm to 7 × 7 cm	300 r	5,000 r	18 days
7 × 7 cm to 10 × 10 cm	250 r	5,000 r	20 days
10 × 10 cm to 15 × 15 cm	200 r	4,500 r	22 days

We use 220 K V P and 20 ma, because the additional 20 K V P improves the quality and intensity slightly, with heavy filtration, over 200 K V P and 25 milliamperes. Taylor (3) analyzed one of our copper absorption curves and states that the voltage at 220 K V P is "180 K V equivalent potential, using 0.22 mm Cu filtration." We use a 25 cm distance, as it is the closest convenient working distance with our flexible shockproof tube holders. We employed a 50 cm distance before the advent of shockproof tube holders with equally good results—the distance is now

decreased merely to save time. The intensity has varied from 16 r to 76 r per minute. Contrary to the experience of others, we have observed no difference in results or skin reactions with this wide variation in intensity. We are convinced that the minimum filter which should be used is 2 mm Cu or its equivalent Thoræus tin filter. We have tried less filtration and the results are not satisfactory. Trophic ulcers are certain to develop if the dosage in the chart is given with filtration less than 2 mm Cu.

We have treated 12 cases, using filters varying from 0.25 mm Cu to 1.0 mm Cu, and in this group four trophic ulcers developed and in all cases there was excessive skin damage and slow healing. We are indebted to Dr. Bloodgood for a successful treatment of trophic ulcers that controls the pain and rapidly cleans up the slough. Periodically, the loose necrotic tissue is cut away with scissors, and 90 per cent phenol is applied until the tissue turns white, it is then neutralized with 95 per cent alcohol. This is continued until the slough disappears.

Many radiologists and physicists have for years maintained that 0.5 mm Cu is the practical and useful limit in filtration at 200 K V P. Our clinical experience during the past two years forces us to abandon this idea. In fact, we are now convinced that 2 mm Cu should be the minimum filtration for 200 K V P therapy in the treatment of malignancies, and as soon as the voltage can be raised economically, our minimum filter will be increased. All treatments are given daily except Sunday, and usually in a minimum of 19 days and a maximum of 22 days. At least 1 cm of healthy tissue is irradiated beyond all visible and palpable evidence of malignancy. If there is any doubt as to the extent of the lesion, it is perfectly safe to irradiate several centimeters of healthy skin margin. Biopsies are taken on all cases after they have been given approximately 1,000 r. Biopsies are done to substantiate the clinical diagnosis. We do not let them influence our dosage, as many times our pathologist has reported squamous-cell carcinoma in one portion of

* All roentgens in this paper are measured in air.



Fig 4 Case 1 Healed, two months after treatment

Fig 5 Case 2 Before treatment, cartilage is exposed

Fig 6 Case 2 Completely healed, two months after treatment Healed now, 10 months



Fig 7 Case 3 Before treatment

Fig 8 Case 3 Completely healed five months after treatment Healed now 15 months

the section and basal cell carcinoma in another. Each case gets the maximum dose, as we know it will destroy the most resistant skin carcinoma and is safe in the radio-sensitive types.

The daily dose depends on the size of the

area treated. It is our experience that the minimum total dose by this method which will destroy squamous-cell carcinoma and adenocystic basal-cell carcinoma is an intense blistering or epithelitis. This epithelitis usually begins about the day the

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² All roentgens in this paper are measured in air

days' time The reaction is relatively painless compared to its appearance and intensity The most important part, however, is the complete destruction of all surface epithelium and carcinoma cells, with a

the patient must have a trophic ulcer because of intensive and prolonged radium treatment (Fig 1) Biopsy reported transitional cell carcinoma

The treatment given was as follows 220



Fig 11 Case 4 Healed two months after treatment



Fig 12 Case 4 Present condition showing rubber compound nose Healed now one year

minimum damage to the dermis and supporting skin structures We believe there is a different biologic reaction to these short wave lengths Whether or not this is an actual or apparent biologic specificity to short wave lengths we do not know *The important point is that we do get a different skin and subcutaneous reaction so that the lethal threshold between skin and dermis is widened*

CASE REPORTS³

Case 1 W S H, a white male, private patient, aged 67 years At the onset, in 1924, there was a small nodule on his nose This was removed surgically, in 1925 but recurred soon after During the next seven years he had an average of three radium treatments yearly It never permanently healed His referring physician thought

K V P, 20 ma, 25 cm distance, Thoræus tin filter, 2.5 cm portal, 380 r daily, 76 r per minute, time, 5 minutes, 5,700 r total dose in 18 days' time

Figure 2 shows the shockproof tube holder with a special cone for 25 cm distance Figure 3, eleven days after treatment, shows a normal blistering reaction which subsided 25 days after treatment Figure 4 shows the lesion completely healed two months after treatment it has been well now for three months This recent case illustrates two points, first, the referring physician thought the patient had already received the maximum amount of irradiation and had a trophic lesion In spite of this previous irradiation we were able to safely administer a cancericidal dose of x-ray without breaking down the nasal cartilage Second, a so-called resistant lesion responded to this dosage—it had merely been inadequately treated previously

³ Fourteen cases were presented before the Radiological Society of North America Space limitations allow the presentation of only four here

treatment is concluded and, as a general rule, heals from three to six weeks later

We find that all patients tolerate these intense blistering reactions without objection if told before the treatments are insti-

cancers Cases that supposedly have had the maximum amount of irradiation without cure, and do not actually have a trophic ulcer present, can be safely and successfully treated Extensive epitheliomas involving



Fig 9 Case 4 Before treatment, cartilage is exposed. Note telangiectasis on cheek from previous roentgen treatment

Fig 10 Case 4 Beginning blistering reaction, five days after treatment

tuted that their skin is going to be blistered just as though it were intensely sunburned. If the epithelioma has destroyed a large amount of tissue, this fills in slowly until complete healing occurs. We have seen exposed, eroded cartilage completely recovered with normal, healthy mucosa or skin. During the period of treatment and healing, secondary infection must be avoided by instituting a strict régime of cleanliness. Hydrogen peroxide, dilute alcohol, soap and water irrigations, mercurochrome, green soap and H_2O_2 , equal parts, are the agents we commonly use. Following the twice daily cleansing, nupercanol ointment 1 per cent is applied with white vaseline to control the burning and itching.

It is now possible for us to successfully irradiate lesions that in the past we considered radioresistant. We have, in fact, acquired a new concept of "x-ray fast" lesions. In our more recent experience such lesions have proven to be inadequately treated

cartilage have given brilliant results. Using this technic, in the 25 cases we have thus far treated, we have had only two trophic ulcers develop. One was due to secondary infection caused by lack of cleanliness, the other was treated early in our series, and we have since learned that it was over-treated. We have had one marginal recurrence one year after treatment, due, we believe, to treating too small an area. Twenty-three of the 25 patients have been free from complications and all evidence of carcinoma from three to twenty-seven months.

The success of this method is primarily dependent upon two factors, but the problem is so complex that we are unable to state which factor is the more important—the heavy filtration (2 mm Cu) or the fractional treatment. We believe that both are essential. This form of treatment produces a reaction which is entirely unlike the usual x-ray reaction with light filtration (Al filters or 0.5 mm Cu) given in a few

is an example of several we have had showing that this cancericidal dose of x-rays can be safely administered in cases in which there is telangiectasis and trophic changes from previous irradiation. This patient also demonstrates how the exposed, eroded cartilage is completely recovered by nor-

mal mucosa after the malignancy has been destroyed

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Case 2 E H, a white male, private patient, aged 70 years. Onset in 1927, as a small hard nodule behind the right ear where the ear piece of spectacles had irritated the skin. No treatment was given other than home remedies. The lesion has alternately healed and ulcerated for the past five years (Fig 5, before treatment). Biopsy report was transitional carcinoma cell.

The treatment given was as follows: 220 K V P, 20 ma, 25 cm distance, 2 mm Cu plus 1 mm Al filter, 4×4 cm portal, 300 r daily, 75 r per minute, 4 minutes' time, 4,800 r total dose in 22 days' time. The height of the reaction was a painless, blistering which was obtained 10 days after treatment, the reaction subsided in four weeks (Fig 6, completely healed in eight weeks). It has been healed now 10 months. Perfect cosmetic result without sacrifice of any portion of the ear.

Case 3 This case is presented as an example of the successful treatment of a resistant lesion that had previously been inadequately treated by ourselves over a five-year period. G M C, a white female, private patient, aged 44 years. Onset, in 1928, as a small crusted papule on the left temple. First treatment the lesion was destroyed by electrodesiccation. In February, 1928, there was a recurrence in 1929. The second treatment was 30 mg-hrs unfiltered radium contact distance. There was a recurrence in 1930. At the third treatment the lesion was destroyed by electrodesiccation—area 2 cm in diameter. The fourth treatment, in 1930, destroyed by electrodesiccation, recurrence in 1931. The fifth treatment destroyed by electrodesiccation, recurrence in 1931. The sixth treatment, in 1931, was 2,900 mg-hrs radium, 0.5 mm lead filter, 2 cm distance. The lesion failed to heal. The seventh treatment, in 1932, consisted of a total of 1,235 r in four treatments at three-week intervals, filtered through 5 mm Al. The lesion failed to heal. A consultation was held, and it was decided that the lesion was lupus vulgaris. The patient was given potassium iodide for 10 months, during

1933, with some improvement. In November, 1933, the lesion was 3 cm in diameter. Biopsy report was a basal-cell carcinoma. It was decided to give the patient deep therapy, with heavy filtration. Figure 7 shows the lesion before treatment. The eighth treatment was as follows: 220 K V P, 20 ma, 50 cm distance, 2 mm Cu plus 1 mm Al filter, 4×4 cm portal, 250 r daily, 22 r per minute, 11.5 minutes' time, 5,000 r total dose in 23 days' time.

The height of reaction was blistering 10 days after treatment. Figure 8 shows the lesion completely healed five months after treatment. Healing was slow due to many previous treatments and poor blood supply. Healed now (15 months).

Case 4 R D C, a white female, private patient, aged 48 years. Onset, in 1924, as a small ulcer on the right side of the nose. It was destroyed by electrodesiccation, but failed to heal. Had weekly x-ray treatments for several months until blistering reaction was produced. Patient thought she was "burned" and refused further x-ray. The lesion never healed. In 1928, a destructive paste was applied which destroyed a large portion of nose. There was no further treatment until referred to us. Figure 9 shows the lesion before treatment: note telangiectasis from former x-ray treatments, also exposed, eroded cartilage. Biopsy report was transitional cell carcinoma. The treatment was as follows: 220 K V P, 20 ma, 50 cm distance, Thoræus tin filter, $5 \times 5 \times 2$ cm portal, 300 r daily, 24 r per minute, 12.5 minutes time, 5,000 r total dose in 20 days' time (Figs 10 and 11). The patient complains only of a sore tongue. The exposed cartilage shown in Figure 11 was completely recovered two months later with healthy mucosa. Figure 12 was taken nine months after treatment, showing a rubber compound nose modeled by Dr William Meloy, healed now (one year). The patient worked daily during treatment, except that during the blistering stage she took one month off. During treatment and until healing occurred the nose was irrigated twice daily with 2 per cent soda bicarbonate solution. This case



Fig 3 Case 2 Mr T R C, aged 35 years (Reg No 75476) Medullary and subperiosteal osteogenic sarcoma



Fig 4 Case 2 Photomicrograph of tissue

mors occur in the long bones of the extremities

In 17 years there have been 210 primary tumors of bone recorded in the Scott and White Clinic from a total of 144,889 clinic registrations, or approximately one in 690 admissions. Of these 210, there are 35 which have been classified as malignant, through the criteria of history, physical examination, and roentgenologic study. In addition, 23 of the 35 have had biopsy, post-operative, or postmortem pathologic examinations. Thus it will be seen that in this institution one primary malignant bone disease has been encountered in approximately 4,000 clinic admissions.

Roentgenology has contributed to a better understanding of this condition, because it offers a superior method of skeletal examination, but it is to be remembered

that there are yet some unsettled problems in relation to classification. Some of the earlier writings, after the advent of roentgenology, would indicate that the lines of distinction were sharply drawn between the benign and malignant groups, and that the further subdivision of these two classes might be comparatively easy. However, the frank confessions of the more recent articles would indicate that not all the problems are yet settled. Even the more experienced men are sometimes perplexed, as they often find that features which have been conceded as peculiar to certain forms of the disease, may also be found in other forms. In a recent discussion at the Southern Medical Association, a prominent roentgenologist remarked "Ten years ago I could make a differential diagnosis, but now I confess I cannot always do so." Goodwin (3) states "There are osteogenic sarcomas, the diagnosis of which is quite plain from the clinical and roentgenologic studies. Again, there are tumors which show such variations that the methods of diagnosis, including biopsy and radio-

OSTEOGENIC SARCOMA¹

ROENTGENOLOGIC CHARACTERISTICS

By R T WILSON, M D , F A C R , *Temple, Texas*

OSTEOGENIC sarcoma may be defined as a primary malignant tumor derived from tissues which normally produce bone. Naturally most of these arise in bone, but recent reports (1) in the literature indicate that bone-forming malignant tumors have been observed in the thyroid gland and other organs not associated with bone. If it is true that any primary bone tumor may be regarded as a potential malignancy (2), and if, in spite of all known therapy, the disease carries an unusually high mortality rate, it is obvious that most earnest consideration of this rare disease is justifiable.

It is presumed that any new development will be presented. The purpose of this paper is, then, to record a limited experience, and to reiterate some of the well-known facts and thereby, if possible, to encourage further interest in this sector of malignant disease.

The great volume of literature written in recent years would seem to indicate a revival of interest in this subject. This has doubtless been stimulated by the establishment of the Bone Sarcoma Registry by the American College of Surgeons. The good work which this organization is doing is to be commended, and it is hoped that

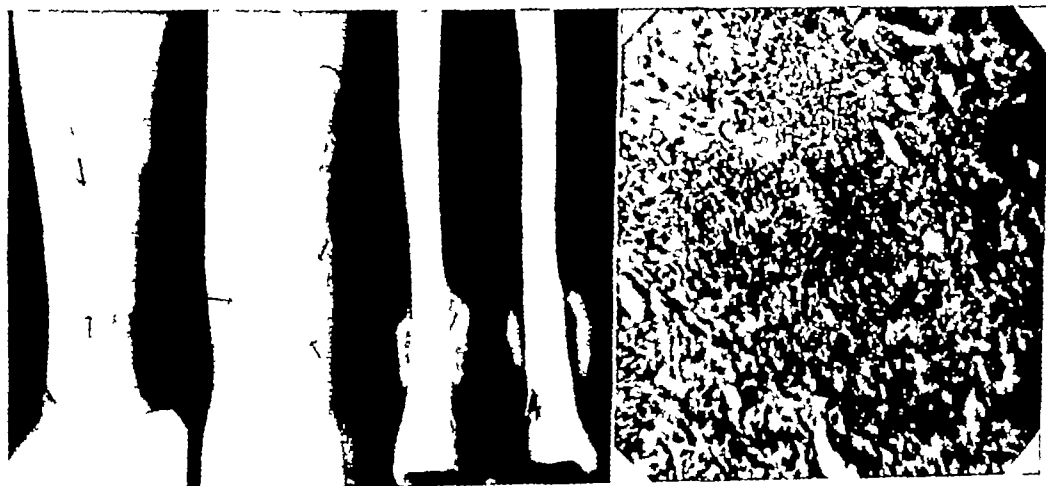


Fig 1

Fig 2

Figs 1 and 2 Case 1 Mrs C T T Jr aged 22 years (Reg No 72843) A fusiform osteogenic sarcoma—periosteal type Grade II

From the reports in the literature, one is impressed with the comparatively small number of primary bone malignancies encountered, even in the large clinics. Doubtless, there are many in this assembly whose experience with this rare disease far exceeds that of the writer, and it is not

through this or some such means there may be established a more hearty co-operation of all practitioners who deal with this condition. It is hoped to develop thereby a greater diagnostic accuracy and a more effective therapeutics.

The first thought in connection with malignancy is the conservation of life, and in osteogenic sarcoma the conservation of limb also, since the majority of these tu-

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis Tenn Dec 3-7 1934

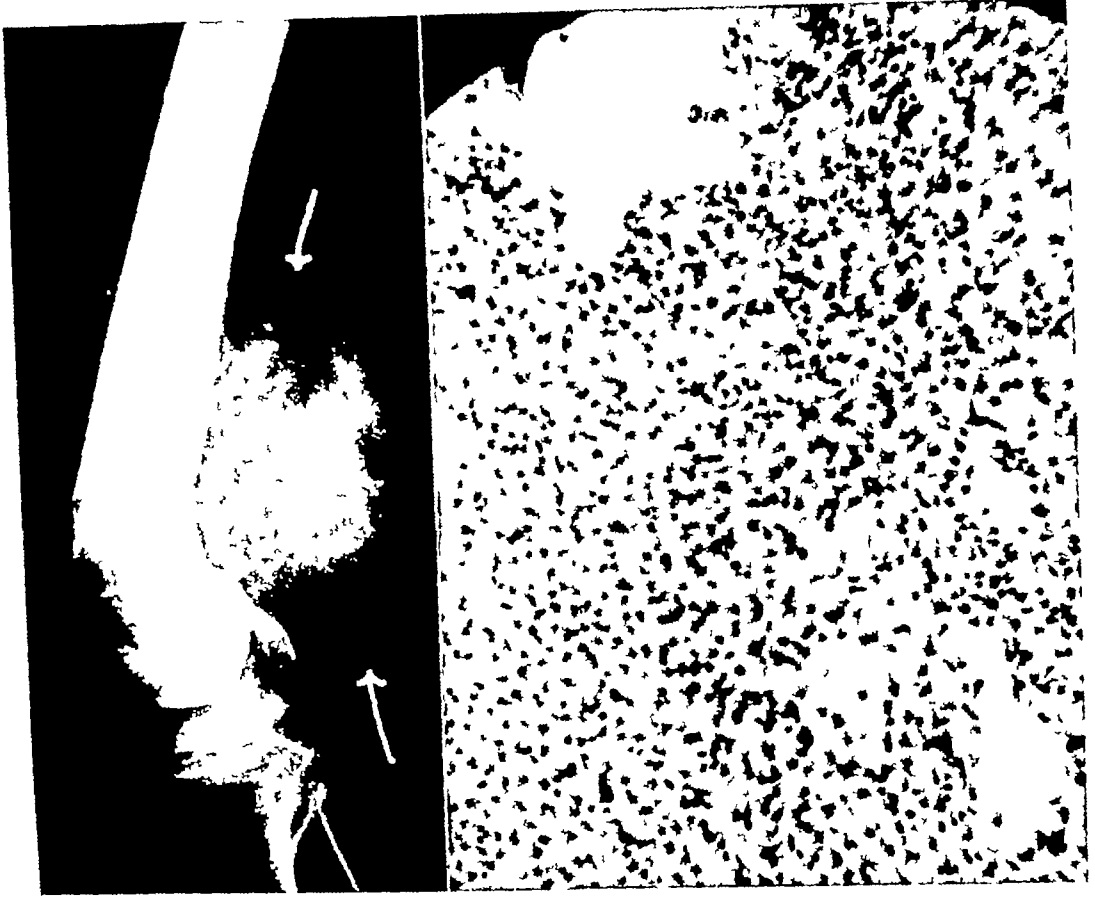


Fig 7

Fig 8

Figs 7 and 8 Case 4 Mr S H R, aged 40 years (Reg No 72931) Periosteal chondrogenic sarcoma lower end of femur

These bone tumors appear, as a rule, in young persons. The average age of our cases was 30.7 years, ranging from eight, the youngest, to 69, the oldest. Fifty per cent gave a history of trauma. Thirty-two of the 35 had pain. The average length of history is seven months, if we except one patient whose trouble began 34 years previously with injury.

Case 1 Mrs C T T, Jr (Reg No 72843), aged 22 years, minister's wife, was admitted to the Scott and White Clinic, Aug. 22, 1929, with the chief complaint of swelling in the lower third of the right leg. Three and one-half months previously she had sprained her right ankle. Three weeks after the injury, two distinct, painless tumors formed, which apparently did not increase in size until one month previous to admission, when they began to grow.

One week before admission, the leg became extremely painful.

Physical examination revealed nothing of significance except that the lower third of the right leg was definitely swollen—there was a slight increase of local temperature, but there was no discoloration. The skin over this area was tight and shiny. Two small tumors were found which seemed firmly attached to the bone. There was a slight anemia, the hemoglobin was 70 per cent, the red blood cell count was 4,128,000. The roentgenogram of the chest was negative. Roentgen-ray examination of the leg showed an elevation of the periosteum of the tibia on both the inner and outer aspects of the bone, involving the greater portion of the lower third, and on the inner side there was a slight erosion of the cortex at one point. A soft



Fig 5



Fig 6

Figs 5 and 6 Case 3 Mr L G M, aged 63 years (Reg No 78895) Chondroma with myxomatous regression involving astragalus

therapy tests, leave one in doubt as to the true nature of the cases. To err one way may mean the loss of a patient who might have been saved by early radical means. To err the other way may result in an unnecessary, mutilating operation."

A clinical conference with colleagues for consideration of history, symptomatology, and physical features may often clarify a difficult situation, and doubt may still exist even after microscopic study. If the latter be necessary for final decision, it should, of course, be done in a manner that will conserve the patient's best interests and not lessen his chances for improvement or recovery. It is predicted that through the co-ordinated efforts of the roentgenologists, pathologists, and orthopedic surgeons these perplexities may be simplified in time, resulting in greater conservation of life and limb.

Whether encountered incidentally or in a direct search for bone pathology, the roentgenologist's problem may be concisely stated as follows: Are changes depicted here due to developmental anomaly or to

an acquired process? If acquired, is the condition one of acute infectious origin or of a neoplastic character? If the preponderance of evidence is in favor of neoplasm, then is it benign or malignant, primary or metastatic? Even these classifications are not always easily made. For instance, osteomyelitis, especially the more chronic sclerosing cases, may simulate Paget's disease or even Ewing's tumor, and sometimes it is difficult to distinguish giant-cell tumor, cyst, and osteochondroma.

In general, the benign nature of a bone lesion is usually determined on the basis of the very dense bone structure, the confinement of the growth to the shaft (though this may be expanded), and the more liberal bone production about the margins of the diseased process, whereas, for the most part, malignancy exhibits destruction of the substance, changes in the medullary and cortical arrangement, elevation or destruction of the periosteum, expansion of the cortex, erosion of the cortex, and irregular deposits of new bone through a soft tissue mass outside the shaft.

of the bone shaft with considerable expansion of the cortex and rather scanty, irregular deposits of new bone throughout a soft tissue mass. There had been a fracture through the tumor, which was not healed. This case was regarded from the history, physical, and roentgenologic findings as one of osteogenic sarcoma, which was growing rapidly at this time. This growth in the lower end of the radius also represents one of rare location. An amputation was performed above the elbow, and a fixed section was reported by the pathologist as medullary and subperiosteal osteogenic sarcoma. A portion of the specimen was sent to Dr W B Coley, of New York, who confirmed the diagnosis. The patient died at his home nine months later.

Case 3 Mr L G M (Reg No 78, 895), aged 63 years, a farmer, registered at the Clinic on Aug 18, 1930, with the chief complaint of soreness in the left foot. His present illness began the preceding Fall, when he noted some discomfort in his foot, which developed after he had been on his feet irrigating his farm. The foot began to swell, mostly on the anterior surface, but never became very large, nor did it get red or hot. When admitted, the patient was still able to walk and was fairly comfortable, but wished to be examined to determine the nature of the condition.

A tentative clinical diagnosis of arthritis was made, but after roentgen-ray examination this was changed. The roentgenogram showed bone changes in the anterior half of the astragalus, characterized by a sort of honey-comb appearance with rather dense bone structure, small cavities, and rather dense trabeculae, and some expansion of the cortex and narrowing of the joint space between this and the navicular. A notation was made that a comparison with films made elsewhere from four to six weeks previously showed little or no change. The character and density of the tumor mass, the slight change in one month, and the lack of bone invasion into the soft tissues indicated a chondroma or giant-cell tumor. A biopsy was per-

formed, and the pathologist reported chondroma with myxomatous regression. Amputation was done six days later, and final study of the pathologist confirmed the original diagnosis. The patient made an uneventful recovery and left the hospital in ten days, against the surgeon's advice. Like the two previous cases, the occurrence of malignant disease is rare in this location. This case also represents an example of malignant change in what was probably a benign lesion originally.

Case 4 Mr S H R (Reg No 72,931), aged 46 years, gave the chief complaint of pain and swelling of the left knee. A horse fell with this patient 34 years previously, injuring the left knee. Ever since that time the knee had been weak and at times painful. Six years before admission he had noticed a small lump, which seemed attached to the bone on the external posterior region of the knee. This gradually grew in size, with only slight discomfort, until four years before admission, when he began to have severe pain, extremely so at times. The mass had gradually increased until the knee had become involved in a large swelling and the joint practically fixed. The patient had been unable to walk, having been in bed for the past nine or ten months. For the past two or three months he had had pain and swelling in the left hip and groin. Until recently, he had been treated for rheumatism with massage and "magnetic" applications, as he called them, but he had grown worse. The pain increased until he became unconscious—the patient was in that condition when brought to the Clinic. There was a history of venereal infection twenty-five or thirty years previously, and his Wassermann at the time of admission was positive. Under a few weeks of anti-syphilitic treatment he seemed to improve, especially as to his mental condition.

A clinical diagnosis of sarcoma of the lower end of the femur was made, and the x-ray showed a large, soft tissue tumor about 15 cm in diameter, principally on the posterior aspect. The medullary canal was apparently not involved. There was a

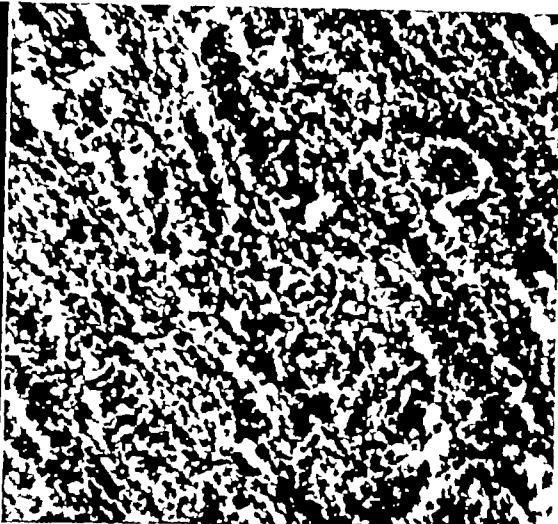


Fig 9

Fig 10

Figs 9 and 10 Case 5 W B, male aged 10 years (Reg No 68714) Osteogenic sarcoma Grade IV

tissue mass was shown, through which there were very faint, irregular bone deposits that were slightly more distinct on the outer aspect and posteriorly. There was no expansion of the shaft but definite destruction of the cancellous bone. These findings were regarded as typical of osteogenic sarcoma, probably arising in the periosteum. The location in the lower end of the tibia is rather rare.

Two days later, an amputation near the junction of the upper and middle thirds of the leg was performed, and the pathologist reported a fusiform osteogenic sarcoma of periosteal type, Grade II malignancy. The patient made an uneventful recovery and was subsequently given 200 K V roentgen radiation. Her progress was entirely satisfactory, and at the time of her last visit, seven months after operation, she felt well. She was wearing an artificial limb. There was no evidence of metastasis to be found in the glandular system or chest.

Three months later, a letter from her husband stated that one week after her last visit to the Clinic she developed a violent illness, with nausea and vomiting. After slight improvement, about the eighth day, she developed heart and kidney complica-

tions, and was taken to a Galveston hospital where she died within a few days of an acute uremia. No necropsy was done.

Case 2 T R C (Reg No 75,476), aged 35 years, a dairyman by occupation and a World War veteran, entered the Clinic with the chief complaint of pain and swelling in the right forearm. While in action during the War, he had had two shrapnel wounds in the right forearm. He was told at the time that he had a greenstick fracture of the radius. Two years ago (1928), a small, hard, painless mass appeared on the radial side of the forearm near the wrist. This gradually became larger, and within one year became painful, and for the last eight months he had carried it in a sling. He had two radium treatments, administered during the months of June and November, 1929, in an army hospital.

In February, 1930, he entered our Clinic, and on examination the distal third of the right forearm was two to three times the normal size. The mass was solid, firm, and tender. The patient had little use of the hand and fingers, which showed considerable edema. X-ray examination of the forearm revealed a pathologic process involving the lower half of the radius, characterized by almost complete destruction

BONE LESIONS IN CHILDREN¹

By JOSEPH I MITCHELL, M D , *Memphis, Tennessee*

THE bones of the child differ from those of the adult skeleton in structure and composition, and, as a result of these variations, the osseous reaction to pathologic processes varies at different age periods. The bone of the child being more vascular is subject more frequently to infection of hematogenous origin and being less compact is more quickly destroyed by infection, also, being less compact than adult bone it will yield more readily under pressure or strain. On the other hand, the greater vascularity and the inherent power of growth and repair of young tissues result in rapid bone proliferation and, at times, complete restoration after injury or disease. Affections peculiar to the epiphyses may occur only during the period of growth, certain diseases of infancy and childhood affect the epiphyses primarily, retarding growth and producing deformities. Trauma is common in childhood and may be a predisposing or direct etiologic factor in many bone affections. Neoplasms of bone, both benign and malignant, are more prevalent during the early decades of life, while metastatic lesions in bone are rarely seen in childhood.

The value of the roentgen ray in diagnosis of bone lesions cannot be overestimated, however, as a means of differentiation, the roentgenogram alone is not always conclusive. Frequently, to one of experience, the roentgenogram is diagnostic, more often it is suggestive, but at times it may be misleading unless the findings are correlated with the clinical and other laboratory evidence. The roentgenologic findings in the more common bone lesions of children will be discussed.

Disturbances of Growth—To review certain well-known facts, the growth centers, or epiphyses, are located at the extremities

of the long bones. Growth of the epiphyses may be arrested temporarily by various diseases, this disturbance being manifested later by transverse lines of condensed bone which remain throughout life. The epiphyses are resistant to infection but, in acute inflammatory processes, the incident hyperemia may act as a stimulus to growth and cause the bone to increase in length, thus, following osteomyelitis, the affected bone may be longer than the one on the opposite side. More frequently the destructive process causes partial or complete arrest of growth, with shortening of the bone. Traumatic separation of an epiphysis may also cause premature ossification and resulting arrest of growth. After loss in continuity of bone there will be compensatory hypertrophy of all osseous tissue on which additional strain is placed. Thus, after loss of continuity of one of the bones of the forearm or leg, the adjacent bone will hypertrophy to compensate for the defective bone. Trauma may cause a local myositis ossificans, if particles of bone or periosteum are detached, and institute bone proliferation in the adjacent muscles.

PYOGENIC AND LOW-GRADE INFECTION

Osteomyelitis—The primary focus in acute infectious osteomyelitis is usually in the cancellous bone, near the epiphysis, but at the onset there may be no osseous reaction that can be demonstrated by the roentgen ray. The roentgenogram is consequently of diagnostic value in the early stage only for excluding other pathologic processes. The first manifestation, observed two or three weeks after the onset, is proliferation of the periosteum about the infected area. Later the roentgenogram is of great value and shows destruction with loss in density in the affected portion of the bone. The degree of decalcification is

¹ Read before the Radiological Society of North America at the Twentieth Annual Meeting in Memphis Tenn Dec 3-7 1934

slight elevation of the periosteum, and an irregular deposit of new bone was noted throughout the soft tissue mass. There was no evidence of pulmonary metastasis, although there was some inguinal and femoral gland involvement. Because of the slow progress of the tumor without lung metastasis, amputation was advised and performed. The pathologic report was a periosteal chondrogenic sarcoma.

The patient made an uneventful recovery and returned for x-ray treatment in one month, three months, and again in ten months. At the latter visit, he had extensive metastasis in the lungs and did not return for further care.

Case 5. Master W. B. (Reg. No. 68-714), aged 10 years, entered with the chief complaint of swelling in the right leg. For about a month his parents had noticed a swelling on the outer side of the lower third of the thigh, and had observed that he complained of a little pain. The swelling was noticeably increasing, as had been pain during the last two or three weeks. About two weeks previously, the patient had received a blow on the thigh, since which time the pain had been worse, especially when walking. Physical examination showed a hard smooth swelling about three inches in diameter on the lateral side of the lower third of the thigh. The overlying skin was movable but apparently attached to underlying tissues. The growth felt as if it arose from the bone and seemed to extend posteriorly into the popliteal fossa. X-ray examination showed a considerable number of right-angle radiating lines of bone deposit, especially on the exterior and posterior aspects of the femur, involving the lower five inches of the shaft. On the exterior

and anterior aspects there was some erosion of the cortex, with complete destruction of the periosteum and of the medulla. This bone deposit was not confined, apparently invading the soft tissues, and was, therefore, considered to be of malignant nature. Some authors deny that right-angle radiating lines are characteristic of malignancy, claiming the deposit of bone may be in various forms and that there may be several varieties of arrangement of the new bone in the same case.

The clinical and roentgenologic evidences in this case pointed to osteogenic sarcoma. Amputation was performed at the junction of the upper and middle thirds of the thigh. The pathologic report was osteogenic sarcoma, sub-periosteal type, Grade IV malignancy. The patient left the hospital in good condition and did not return for further observation.

SUMMARY

Osteogenic sarcoma is a relatively rare disease. It occurs chiefly in young persons. It frequently follows trauma, which may be of a rather trivial nature. It is practically always associated with pain. The roentgen-ray appearance is the chief factor in diagnosis. The history and physical examination will often assist in the differential diagnosis. When doubt still exists, biopsy may be performed under certain conditions, though this is rarely satisfactory. The treatment should be early and radical, because the mortality rate is unusually high.

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BONE LESIONS IN CHILDREN¹

By JOSEPH I MITCHELL, M D , *Memphis, Tennessee*

THE bones of the child differ from those of the adult skeleton in structure and composition, and, as a result of these variations, the osseous reaction to pathologic processes varies at different age periods. The bone of the child being more vascular is subject more frequently to infection of hematogenous origin and being less compact is more quickly destroyed by infection, also, being less compact than adult bone it will yield more readily under pressure or strain. On the other hand, the greater vascularity and the inherent power of growth and repair of young tissues result in rapid bone proliferation and, at times, complete restoration after injury or disease. Affections peculiar to the epiphyses may occur only during the period of growth, certain diseases of infancy and childhood affect the epiphyses primarily, retarding growth and producing deformities. Trauma is common in childhood and may be a predisposing or direct etiologic factor in many bone affections. Neoplasms of bone, both benign and malignant, are more prevalent during the early decades of life, while metastatic lesions in bone are rarely seen in childhood.

The value of the roentgen ray in diagnosis of bone lesions cannot be overestimated, however, as a means of differentiation, the roentgenogram alone is not always conclusive. Frequently, to one of experience, the roentgenogram is diagnostic, more often it is suggestive, but at times it may be misleading unless the findings are correlated with the clinical and other laboratory evidence. The roentgenologic findings in the more common bone lesions of children will be discussed.

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Osteogenic sarcoma is a relatively rare disease. It occurs chiefly in young persons. It frequently follows trauma, which may be of a rather trivial nature. It is practically always associated with pain. The roentgen-ray appearance is the chief factor in diagnosis. The history and physical examination will often assist in the differential diagnosis. When doubt still exists, biopsy may be performed under certain conditions, though this is rarely satisfactory. The treatment should be early and radical, because the mortality rate is unusually high.

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requires emphasis, owing to the importance of its clinical application, is that a fragment of bone completely cut off from the circulation so that it is avascular will retain its original calcium content, whatever changes may occur in the adjacent vascular bone. The sequestrum is dense and stands out in marked contrast to the surrounding atrophic bone. If, therefore, in the presence of generalized decalcification, one fragment of bone has retained its normal calcium content, the radiologist can say with certainty that the fragment is avascular and is therefore a sequestrum. After healing has taken place the bone is sclerosed and anemic, massive hypertrophy and increase in density are observed at this stage. The bone cortex may become so dense and hypertrophic that active processes, sequestra, or cavities within the interior may be obscured.

Osteomyelitis of Garré—Chronic sclerosing osteomyelitis is a painful non-suppurative bone lesion found in children and adults. The tibia is most often involved and the roentgenogram shows a spindle-shaped enlargement in the shaft, well away from the epiphyses, a distinct thickening of the cortex, with a smooth periosteal covering, and a narrowing of the medullary cavity. It has been suggested that the pain is caused by the inability of the blood to circulate through the dense sclerotic bone. Relief may be secured by drilling multiple holes into the bone or removing a cortical window, but recurrence of symptoms is not infrequent.

Syphilis—Syphilis affecting bones in children is, as a rule, of congenital origin and may be observed only in the tertiary stage. The diagnosis may be suggested by the roentgenogram and is confirmed in 90 per cent of the cases by a positive blood Wassermann reaction. In infancy, congenital syphilis is manifested usually as osteochondritis of the epiphyses. Multiple joint and bone changes are observed, with swelling of the joints and enlargement of the extremities of the long bones. The roentgenogram shows the articular cartilage to be intact, also, that all the

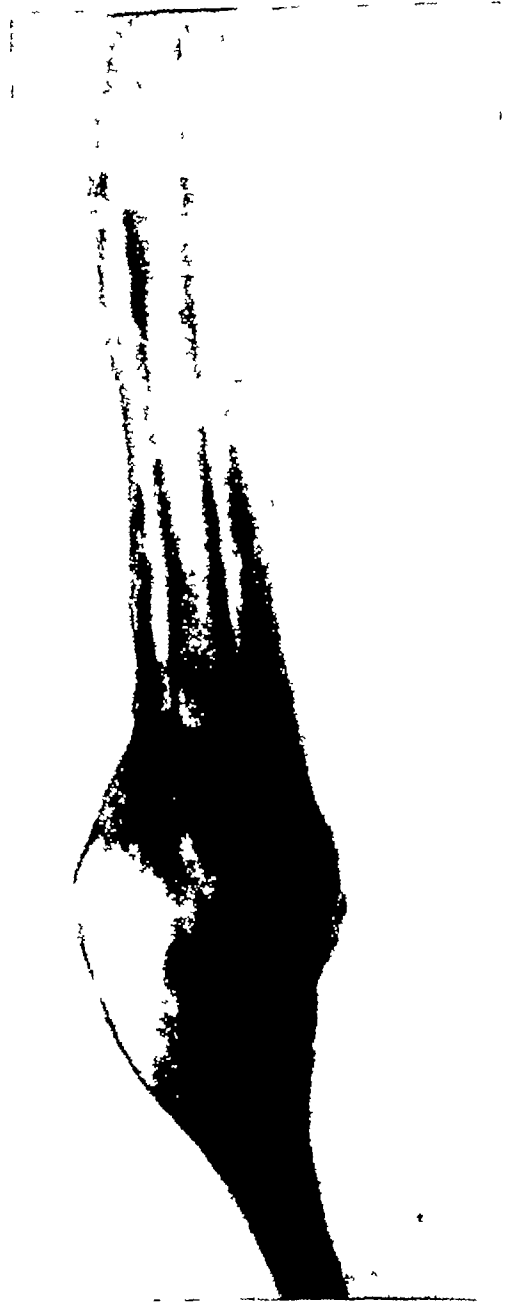


Fig 2 Chronic osteomyelitis of humerus of 14 years' duration. A large sequestrum is present.

pathologic changes are confined to the epiphyseal line and the bone directly behind it. There are present localized areas of softening and punched-out areas of destruction in the bone just beneath the periosteum at the point where the articular cartilage begins. There is no atrophy of

proportionate to the intensity of the hyperemia, and is most severe in the bone and the formation of the involucrum is apparent. The roentgenogram is char-



Fig 1 Premature ossification of distal epiphysis of radius with arrest of growth in a boy 14 years old. This followed traumatic separation of the epiphysis at the age of nine.

hyperemia of acute infection. The periosteum is separated from the shaft of the bone. This is characteristic in the later stages when the sequestra have separated. A fact which

the bone but, on the contrary, there is frequently periosteal new bone production children the syphilitic bone lesion may be either a condensing periostitis or osteo-

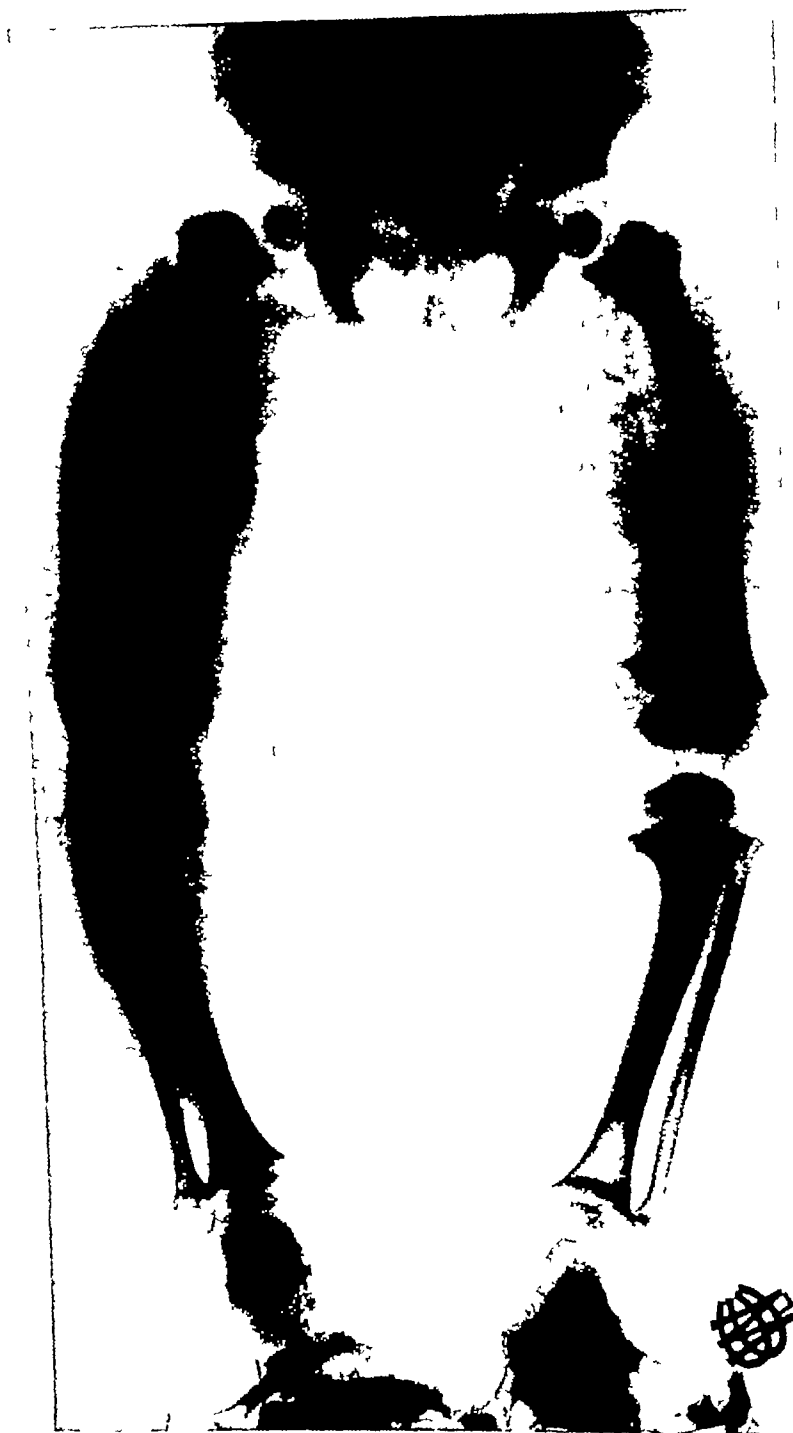


Fig 4 Active rickets in a child two years of age

On the whole, the calcium band shutting off the diaphysis runs regularly In older myelitis in condensing osteitis or periostitis there is proliferation of bone along



Fig 3 Chronic non suppurative osteitis (osteomyelitis of Garré) Note the characteristic thickening of the bone cortex causing a spindle shaped enlargement in the shaft of a long bone

not obtain a sufficient amount of raw fruits and vegetables. The disease is characterized by multiple painful bone and joint

salt deposit (4) A broad irregular edge of dense shadow in the epiphyseal center of ossification (5) A rarefaction of the



Fig 6 Roentgenogram of left upper extremity of patient shown in Figure 5

lesions. The signs by which scurvy may be manifest in the roentgenogram are as follows (1) Irregularity, broadening, and condensation of the preparatory line of calcification, resulting in the formation of the "white line of scurvy," an intensely calcified band at the diaphyseal end of the shaft just proximal to the epiphyseal line (2) There may be a small spur at the lateral margin of the diaphyses which usually points away from the joint (3) A zone of rarefaction which represents lack of lime

central portion of the center of ossification (6) Separation of the epiphyses (7) Atrophy of the bone, resulting in a ground-glass transparency of the shaft with clouding or obliteration of the trabecular structure and a thinning of the cortex to one-fifth of its normal width (8) Evidence of hemorrhage into the soft tissues beneath the periosteum, and later calcification of the hematoma (9) Subperiosteal fractures may occur in the ends of the diaphysis. All of the signs will probably not be found

the periosteal surface and thickening of the cortex, usually on the convex side of the shaft. The bone may be bowed, leading,

leading to bony ankylosis, which, in the residual stage, serves to differentiate acute infectious arthritis from tuberculosis.



Fig 5 Photograph of negro child aged five years showing deformities resulting from multiple fractures in a patient with *fragilitas ossium*

in the case of the tibia, to the condition known as "saber shin." The destructive form or syphilitic osteomyelitis is manifested by a combination of areas of destruction and bone proliferation.

Tuberculosis—The pathologic process of bone tuberculosis begins most often in the metaphyseal region of the bone and extends to involve the entire joint. Joint tuberculosis is rare during infancy and is most common during the latter half of the first decade; it is usually monarticular, with increase of fluid and thickening of the peri-articular tissues. In the early stages the bones appear hazy and indistinct; after several months the articular surfaces become irregular and the underlying bone atrophic. As the articular cartilage and bone on both sides of the joint are destroyed the joint space becomes narrowed. Deformity and subluxation occur in untreated cases. There is little new bone production, and when ankylosis occurs with healing it is usually fibrous in character.

Acute Infectious Arthritis—Pyogenic infection of a joint like tuberculosis is more often monarticular. The destructive process is more rapid than in tuberculosis; otherwise, during the acute stage the two conditions may be indistinguishable from the roentgenogram. As the disease subsides, there is marked new bone production

NUTRITIONAL DISTURBANCES

Rickets—Rickets is a constitutional disease of infancy caused by an insufficient amount of Vitamin D and sunlight, and may be curable by the administration of these agencies. The lesions are multiple and symmetrical, and in the roentgenogram are seen to be confined to the epiphyseal lines. The newly developed bone does not reach full maturity and is composed of osteoid tissue resembling cartilage; this new tissue is softer than normal bone, and the epiphyseal area, which is broadened, tends to spread out. The diaphyseal band is irregularly waved once or twice, and the diaphyseal end of the shaft is broadened and depressed in the form of a saucer, this saucer-shaped expansion being more marked in the weight-bearing bones. The margins of the diaphysis are pointed. The shafts of the bones also become atrophic due to disturbed nutrition and to non-use. This rarefaction and softening lead to bending and distortion of the shaft, also, the bones are easily fractured. As healing takes place, the cortex of the curved bones becomes thickened along the concave surface of the shaft. Rachitic deformities, as changes in shape of the skull, thorax, spine, pelvis, bow legs or knock knees, may persist throughout the life of the individual.

Scurvy—Infantile scurvy is caused by a deficiency of Vitamin C in infants who do

Dyschondroplasia—This condition is characterized by multiple cartilaginous exostoses, and is also designated as hereditary disturbance of ossification of epiphyseal cartilage, resulting in the formation of multiple osteocartilaginous exostoses. The



Fig 8 Juvenile kyphosis in a boy 17 years of age showing wedging of bodies of seventh to tenth dorsal vertebrae and irregularity of the secondary centers of ossification

tary deforming chondrodysplasia, hereditary multiple exostosis, multiple cancellous exostosis, diaphyseal aclasia, and ossified diathesis. The pathology consists of a

tumors are usually painless unless traumatized, and the symptoms are produced only by the mechanical presence of the growths and their interference with normal joint

in the roentgenogram of every case of scurvy but, according to McLean and McIntosh (9), increased density of the bearing structure improves and the frequency of fracture decreases



Fig 7 Roentgenogram of right lower extremity of patient shown in Figure 5

zone of preparatory calcification, peripheral shadow of the center of ossification, together with blurring of the trabeculae constitute sufficient evidence for a positive diagnosis

CONGENITAL AND HEREDITARY DEFICIENCIES

Osteogenesis Imperfecta—Increased fragility of the bones of children may occur congenitally in osteogenesis imperfecta (fragilitas ossium, osteopsathyrosis). The bones are fragile, and multiple fractures occur, usually in the shafts of the bones, and, at times, from very trivial injuries. The epiphyseal lines and centers of ossification are normal. The cortex of the shaft may be thinner than normal and in advanced cases this may be exaggerated from the atrophy of disuse. Firm union of the fractures with good callus is the rule, although there may be distortion of the skeleton as a result of angulation and bending of the softened bones from weight-

Osteosclerosis—Generalized osteosclerosis is a rare bone lesion, beginning early in life. The condition, first described by Albers-Schonberg, is characterized by increased calcification of bone and fragility. The disease has been called "marble bone" but, as mentioned by Jones (7), this term is misleading. He suggests that the name "chalky bone" would be more accurate since, despite their apparent density, the bones are relatively soft, easily drilled, and liable to spontaneous fracture. In the long bones the cortex shows increased density and thickening, with encroachment upon and narrowing of the medullary canal. The ends of the shafts present an expanded appearance, with thinning of the cortex. The small bones such as vertebrae, tarsals, and carpals present a generalized increased density, with absence of bone structure. As yet, there being no recognized vitamin or endocrine disturbance, the cause of the abnormality is not known.

Epiphysitis of the Tibial Tubercle (Schlatter-Osgood Disease)—This affection is observed more frequently in boys and is

Coxa Vara of Adolescence—Another hip affection is epiphyseal or adolescent coxa vara, which occurs more often in boys

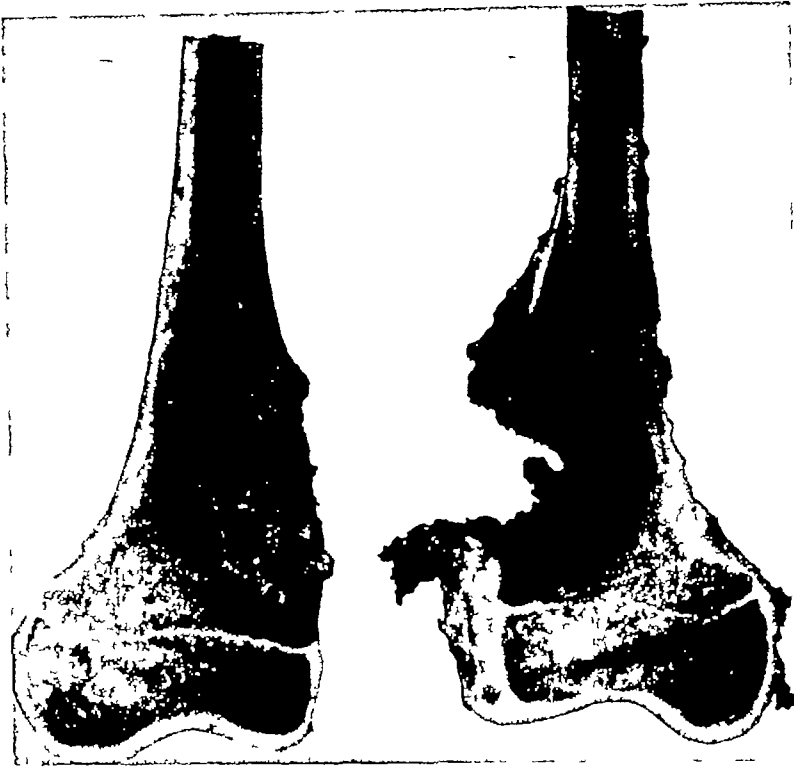


Fig 10 Photograph of specimen after amputation An osteogenic sarcoma of the femur in a boy 10 years old.

usually unilateral but may be bilateral. The roentgenogram shows proliferative and degenerative changes in the tibial tubercle, often with separation and fragmentation of the epiphysis which are diagnostic.

Coxa Plana (Legg-Calvé-Perthes Disease), Osteochondritis Deformans Juvenilis—Coxa plana occurs in the latter half of the first decade and may be unilateral or bilateral. Legg (8) described two varieties, the "mushroom" and the "cap" types. In the mushroom type, the upper femoral epiphysis is rounded and flattened, while in the cap type, the head, though flattened, is not spread out. The roentgenogram shows that the epiphysis is crushed or flattened, with eburnation of the bone beneath the articular cartilage, and fragmentation. The epiphyseal line is wider than normal and irregular, the neck of the femur is broadened

between the ages of twelve and fifteen years. The distribution is usually unilateral although both hips may be involved. Hypopituitarism, or other endocrine imbalance, is a predisposing cause, as the process more often occurs in obese children with Frohlich's syndrome. The roentgenogram of an early case shows absorption along the epiphyseal line; later, the head slides downward on the neck of the femur, decreasing the angle between the neck and the shaft. If the position is not corrected, the head will unite to the neck well below its normal level and a permanent coxa vara will result.

Vertebral Epiphysitis (Juvenile Kyphosis)—A definite disease entity causing dorsal kyphosis in adolescents has been described by Scheuermann (11). The bodies of the vertebræ from the seventh to the tenth dorsal are wedge-shaped, and



Fig 9 Giant-cell tumor of femur. Note multi-locular cystic tumor causing expansion and thinning of the bone cortex

function. Obviously, removal of all the tumors is impossible, but, when necessary, those causing symptoms may be excised. After maturity, correction of osseous deformity may be indicated.

Enchondroma (Dyschondroplasia)—En-

chondromas are benign bone lesions which may affect any of the bones formed in cartilage, and are characterized by the development of bone into osteoid tissue. The epiphyses may be involved, with retardation of growth of the affected bones. Fracture from slight trauma is common but the bones usually unite readily. No treatment has proved beneficial but the process subsides when full growth is attained. Retentive apparatus should be employed to prevent deformity.

Achondroplasia—Achondroplasia is apparent at birth and is characterized by a disproportion between the shortened extremities and a trunk of normal length. In addition to dwarfism, there may be osseous deformity, also, the epiphyseal ends of the long bones are widened. The roentgenologic evidence consists of broadening of the epiphyseal lines and ossification of the epiphyses at an early age, leading to further interference in the growth of the bones.

EPIPHYSEAL AFFECTIONS

Certain of the intra-articular and extra-articular epiphyses may be involved in abnormal processes which present characteristic manifestations. The condition occurs most often in late childhood or near puberty, boys are more often affected than girls, and the affection may be confined to one epiphysis, or may involve two or more in succession, or simultaneously. The etiology is unknown but from the evidence available trauma is a prominent factor, and it is worthy of note that the lesions occur only in the weight-bearing areas of the spine and lower extremities.

Osteochondritis of the Scaphoid (Kohler's Disease)—Between the ages of three and six years, the scaphoid bone may be involved in a process which causes slight pain and a lump. The roentgenogram shows the bone to be flattened in the anteroposterior direction, the density of the bone is increased and the circumference is irregular.

tissues, while the original shaft of the bone may remain visible, passing through the newgrowth. The reaction of the periosteum where it is raised from the shaft produces lipping at the margins of the tumor. In the sclerosing type, new bone may be laid down without structure or in a ray-like manner perpendicular to the shaft, although this finding is not always demonstrable nor diagnostic when present. In the osteolytic type there may be extensive destruction without new bone production.

In Ewing's sarcoma, the roentgenogram shows extensive invasion and destruction of a large area of the bone, with expansion. When the tumor involves a long bone, the shaft may be surrounded by longitudinal strata of new bone deposited in successive layers. In the flat bones, as the ilium, the bone presents a mottled appearance. Malignant neoplasms of bone metastasize to the lungs and the prognosis is un-

favorable, regardless of the treatment employed.

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there are pathologic changes in the secondary epiphyseal centers of ossification. The upper and lower surfaces of the vertebrae are irregularly defined, this irregularity being especially marked at the anterior edge of the body, and the affected bones are atrophic. The disease, which is seen most often between the ages of fifteen and seventeen years, causes a fixed curvature of the spine.

Osteochondritis of the Vertebral Body—Vertebral osteochondritis is analogous to epiphyseal disturbance in other bones during the period of growth, the disease occurs only during the first decade of life. The body of the vertebra is flattened and the opacity increased. The intervertebral discs are not involved.

ENDOCRINE DYSFUNCTION

Dysfunction of the endocrine glands may cause pathologic changes in bone. Stimulation of the pituitary gland produces an increase of growth and delay in ossification, particularly of the epiphyses of the long bones, and results in gigantism. Organotherapy is beneficial in the early stages but when the process is advanced, no treatment is of value.

Recently, it has been proved definitely that the parathyroid glands control the calcium-phosphorus balance of the body and that over-activity of the parathyroids causes absorption of calcium from the bones, with increase of calcium in the blood serum. The bones of the skeleton become cystic, producing the diffuse type of osteitis fibrosa cystica. Associated with the bone changes of hyperparathyroidism are other symptoms of muscular weakness, increased calcium in the blood serum, increased excretion of the calcium in the urine, and nephrolithiasis. Removal of the parathyroid adenoma arrests the disease process, the bone cysts are re-calcified, the blood calcium returns to normal, and the other symptoms are relieved.

HODGKIN'S DISEASE

Skeletal involvement in Hodgkin's disease is more frequent than is generally

realized and may precede the characteristic glandular enlargement. The principal change noted is a progressive fibrous tissue formation within the bone, associated with new bone production. Hyperplasia and degeneration of the bone marrow result in areas of altered density within the medullary portion of the bone and thinning of the bone cortex. Though less common, a generalized periostitis may appear in addition to the medullary involvement.

OSTEITIS FIBROSA CYSTICA

Osteitis fibrosa cystica is observed most often in the upper or lower extremities of the femur or humerus. The roentgenogram shows a central area of bone destruction, with thinning of the bone cortex; the cortex is rarely expanded. There are frequently no local symptoms, and the first manifestation may be fracture through the affected area caused by a slight injury.

NEOPLASMS

Benign Tumors—Osteoma and osteochondroma are composed of bone and cartilage. In osteochondroma, the base of the tumor is composed of bone and the periphery is cartilaginous. The tumors occur near the epiphyseal ends of the long bones, and the process of growth is in an orderly manner, similar to mature bone. The roentgenogram demonstrates a circumscribed newgrowth, the periphery of which may be translucent and irregular while the stalk has the density of normal bone.

Giant-cell tumor is a destructive lesion, occurring usually in the epiphyseal region. The roentgenogram shows a central lesion which may expand the bone cortex; the cortex is also thinned and may be perforated. The interior of the cyst may be divided by bone trabeculae into multilocular compartments, giving rise to the so-called soap-bubble appearance.

Malignant Tumors—Osteogenic sarcoma occurs usually in the metaphyseal area. The tumor is not circumscribed but destroys the bone and invades the soft

The detailed studies of Geschickter would lead one to believe that he thinks osteoblasts are bone builders. Brunschwig and Harmon (5) maintain that evidence for the osteoblasts is conclusive. Gruber (6), on the other hand, denies that the periosteum is the source of bony growth. In Europe, the so-called "humoral hypothesis" of osteogenesis is held by some. Brunschwig and Harmon (7), in a paper just published, discuss this and explain that under this theory the essentials are, proliferating connective tissue, edema, and a reservoir of super-saturation of calcium salts. These authors maintain that their experiments show the fallacy of the humoral hypothesis. Blaisdell (8) and Geddes (9) stand up for the osteogenetic power of periosteum. In the Registry of Bone Sarcomas, osteogenic sarcoma is separated from periosteal sarcoma, but I often wonder if separate divisions are necessary because we are dealing with primitive mesenchymal cells, which are pluripotent.

The increasing number of recorded cases of non-skeletal osteogenic sarcoma is in line with the foregoing statement. Gradually, classifications of tumors have undergone a change in line with newer conceptions of neoplasms not necessarily belonging entirely within one of the three primary germ layers. We allow, of course, for metaplasia, but I note a decrease in use of that term to explain unusual tumor cell mixtures. Osteogenic sarcoma is recorded as occurring in the thyroid of a dog (10), the lung (11), soft tissues (12), liver of the rat in experimental cysticercus disease (13), the kidney (14), the uterus (15 and 16), and the thyroid gland (17). These are among the notable examples. It is probably unwise to draw too many deductions from these facts, but they are at least in support of the idea that tumor cells from mesenchymal origin are capable of doing a variety of things.

Now let us turn our attention to the subject of the etiology of osteogenic sarcoma. All of us are aware of the great amount of work that has gone on and is going on now on cancer. We certainly do not know the

cause, but we most assuredly do know some things today that yesterday were in cloud. Let us discuss briefly only two things, trauma and irradiation. Although the figures on the former still show such wide variations that it will be a matter of choice as to what you want to believe, it still is a matter of concern to us to think back on our own cases in which a definite trauma has preceded an osteosarcoma. I think the two are actively related. As to the effects of irradiation on tissues possibly being responsible for a bone sarcoma, we still must be conservative, although there is no longer doubt as to the cancerogenic nature of certain rays from an x-ray tube and from radium and radio-active substances. An editorial (18), on "Malignant Growths Following Irradiation," states that there are now on record 18 cases of sarcoma following irradiation treatment of joint tuberculosis in man. Animal experimentation supplements these figures with interesting data. The report of Martland (19), summarizing poisonings from radio-active substances, showed a mortality rate of 27 per cent for osteogenic sarcoma. Figures are accumulating to show that osteitis fibrosa and Paget's disease are important diseases contributing definitely to bone sarcoma.

The course of osteogenic sarcoma is so well known that here a brief résumé will suffice. So little is known of the actual happenings of the first stages of an osteosarcoma, that we can only surmise that the initial malignant stimulus is met by cellular increase in proportion to the nature of the agent and its activity, the age of the patient, the position of the lesion in the bone, the presence or absence of trauma, and that great unknown, the resistance of the patient. It may or may not be right to say that these cell changes are originally malignant and not purely benign and reactive. Be that as it may, we know that cell proliferation is active and soon invasive, with osteogenesis or osteolysis, or both. It has been shown experimentally (20) that when a growing tumor elevated the periosteum, new bone was produced, but as soon as the periosteum was broken

OSTEOGENIC SARCOMA ITS PATHOLOGIC CHARACTERISTICS¹

By CHARLES PHILLIPS, M D , *Temple, Texas*

TO the roentgenologist, with his studies in differential tissue density, and to the pathologist, with his histopathologic studies, one of the very interesting developments of the present decade is the increasing importance and volume of work on one phase of neoplasia, that of primary malignant bone tumors. Their incidence is very low but their killing power high. Out of this has grown one typical illustration of the American genius for standardization, a registration system of co-operative voluntary study of bone tumors. Articles in foreign journals show the widespread value of this effort, and the establishment of similar registries for study of other tumors reflects American opinion of its worth and success. It is a matter of pride that your specialty and mine have so largely figured in this work. Let us keep at it with the hope that some day confusion of types and names may be replaced by order and simplicity.

The word "confusion" here is used deliberately, for even after a very long time there still exists a lack of agreement about the whole problem of the histogenesis of bone. There is general concurrence that the skeletal system is of mesodermal origin, and that the later mesenchyme lays down the cellular groundwork from which future separate structures develop. Probably, if we accept the pluripotential nature of these primitive cells, we shall not be surprised at what at times seems to be odd developments. These embryonic mesenchyme cells proceed as a rule in an orderly way, by little understood control mechanisms, to differentiate into various stages of pre-cartilage, cartilage, osteoid, and final bone by deposition of adequate mineral matter. Detailed studies describe special stages of these structures by names which are not given here. There is one term,

however, "differentiation," which has of recent years come to be of great value. In general it denotes an orderly progress toward the normal in tissue development. Pathologists, of course, use the term constantly, but I note in reading that others are catching its significance. By potent and, as a rule, regular acting forces, cortical hard bone, cancellous bone, marrow with its valuable collection of cells, endosteum, periosteum, Haversian systems, osteoclasts, and osteoblasts come into being and relation. We wish at this time to acknowledge a legitimate difference of opinion. There is not complete agreement in regard to the origin and function of endosteum and periosteum as to bone production and particularly as to the origin of osteoblasts and osteoclasts. The Maximow (1) ideal of development of monocyte, histiocyte, and fibroblast shows close relationship of fibroblast to osteoblast. Carrel and Ebeling (2), and others (3), growing tissues in pure culture, show that monocytes, which are ordinarily thought of as blood cells, under some conditions differentiate into fibroblasts. Thus far, we see little result from attempted growth of bone *in vitro*, and so there is no agreement as to these details of histogenesis. Other studies (4) indicate the origin of osteoblasts from angioblastic tissue. Pathologists are more and more describing heterotopic bone formation in the body, and many firmly believe that under suitable conditions the fibroblast, type cell of ordinary connective tissue, may produce true bone completely away from periosteum.

Just as uncertainty exists in regard to the exact details of normal growth of bone, so we find it in studies on bone tumors. There is much evidence to substantiate the idea that in general bone production in a tumor of bone is a reparative attempt to produce intercellular substance, just as fibroblasts produce collagen in ordinary scar tissue.

¹ Presented before the Radiological Society of North America, at Memphis, Tenn., Dec. 3-7, 1934.

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 (21) GESCHICKTER C F, and COPELAND, M M Arch Surg, May 1930 20, 711
 (22) GESCHICKTER, C F Arch Surg, 1932 24, 602 and 798

DISCUSSION OF SYMPOSIUM ON BONE TUMORS

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I have made a few notes of some of the more important diagnostic features of some of the tumors and bone diseases, for it is manifestly impossible in a short time to cover the entire subject.

Of the benign tumors, the exostoses may be single or multiple. They occur frequently near the end of long bones and they may have a pedicle or may be sessile. These tumors are easily recognized on the roentgenogram and, while usually benign, may in rare cases undergo malignant changes. These tumors may be found at any age but occur more frequently between the ages of ten and forty.

Chondromas or chondromyxomas are also benign and are found chiefly in the small bones of the hands and feet, ribs, and cranium. They occur more frequently be-

tween the ages of fifteen and thirty-five. The tumor expands and has a translucent appearance on the roentgenogram. Usually it is single but there may be multiple tumors. In one case a father had a very large chondroma of the sternum for which he was irradiated by me at intervals for many years. His son, aged 17, also had a chondroma of one phalanx, so that the question of heredity enters into some of the tumors.

Bone cyst, which is a benign tumor, occurs more frequently in children and young adults. Pathologic fractures may occur and healing take place. When due to hyperparathyroidism there is demineralization and generalized fibrocystic disease of the skeleton. Blood calcium is elevated and blood phosphorus is lowered. Deep x-ray therapy of the parathyroid and cystic areas may produce an arrest of the disease and healing of the condition. Surgical removal of the parathyroid tumor may be necessary in some cases.

Giant-cell tumor is found usually at the epiphysis of long bones, chiefly in the lower end of the femur, upper end of the tibia, or lower end of the radius in relatively young adults, but it may occur up to the age of forty, after forty, it is rarely seen. In the roentgenogram we find a defect of varying size in the bone more or less trabeculated, surrounded by a bony shell which may or may not be perforated. Roentgen therapy is very useful and may produce complete healing of the tumor.

Of the malignant tumors, the sclerosing osteogenic sarcoma is visualized on the roentgenogram as a dense radiating bone tumor involving the periosteum, usually of the long bones of youthful patients, although rarely the small bones may also be involved. This tumor may also involve the bones of an adult at any age but is more commonly found under the age of twenty-five. The periosteum may appear raised and the new bone may have a ray-like appearance. Histologically, the tumor contains many large osteoblasts and an irregular distribution of osteoid substance. This type of tumor is usually radioresistant. The osteolytic type of osteogenic sarcoma is

through and sarcoma cells invaded adjacent tissues there was no osteogenesis. The occurrence of giant cells in osteogenic sarcoma has been the source of much confusion. Geschickter and Copeland (21) have recently analyzed this subject in discussing metastasis of giant-cell tumors, and conclude that a true giant-cell tumor is benign and never metastasizes but that osteoclastic giant cells may be present in true osteogenic sarcoma, and give trouble to the pathologist who studies the tumor. Although this subject is technical, it may also concern the radiologist in shedding light from biopsy specimens on the nature of certain bone shadows. Let me point out again the difficulty of accurate classification of neoplasms by biopsy, in which usually only one area of a neoplasm is tapped.

There is another problem about the effects of osteogenic sarcoma on the body, and that concerns the location and nature of metastatic deposits. The first of these is well known to the roentgenologist. In the second it is interesting to find the lack of uniformity about pathologic slides of metastases. Do they or do they not form bone? Here again we get into technical details, but it will interest you to find such a lack of agreement among good students. There are, however, two points of common understanding. They are that metastasis may generally be expected unless the lesion was favorable and radically treated, and that these secondary colonies are radio-sensitive to a limited extent.

The pathologist of to-day who gets tumor tissue to study is partially responsible for treatment and results, with the surgeon and the radiologist, and so it may be well to see if we are getting anywhere. In general, figures are discouraging, but we believe that results are not all bad with those bone sarcomas, the cells of which produce much intercellular substance, as bone or fibrous tissue. To be able to tell this we must have tissue for study, and so the necessity for biopsies is urged. A carefully worked up, large series of cases like those of Geschickter (22) and those from the Registry point the way toward a better under-

standing of our problem in its radiologic and pathologic features. If all of us will register our cases for critical study, we may some day see a marked lowering of the present terrific mortality. The radiologist, pathologist, and surgeon are the team picked to win the game.

SUMMARY

It is seen that still much confusion exists as to the details of normal bone development, but that the cells of origin of osteogenic sarcoma are from primitive mesenchyme and capable of developing in several directions. Records of cases of heterotopic bone formation, and those of non-skeletal osteogenic sarcoma are accumulating to a degree of raising questions about the histogenetic relationship of all mesoblastic malignant neoplasms. The importance of effects of various forms of irradiation on the body, and of the more than casual relationship between osteosarcoma and osteitis fibrosa is emphasized.

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highly malignant. There is bone destruction without bone expansion and usually it involves the shaft of the long bones of young adults. This tumor does not commonly respond to irradiation, although that should be tried before amputation. Metastasis to the lungs frequently occurs.

Chondrosarcoma, also known as chondromyxosarcoma, is a periosteal osteogenic sarcoma containing cartilage and may arise secondarily through benign exostosis or benign chondroma. It may be primary, and in that case usually occurs at the site where the tendons are inserted into the bone. It is found between the ages of ten and thirty. In the roentgenogram it is faintly visible as a superiosteal shadow, which may contain a few spicules of bone. The cortex and medullary canal are usually not involved until late in the disease. In the secondary chondrosarcoma, the patient usually has been aware of the existence of an exostosis or chondroma. It commonly occurs after thirty-five years of age and this malignant tumor may be seen on the roentgenogram, destroying the outline of a pre-existing exostosis or chondroma.

Ewing's tumor commonly involves the tibia or femur, although it may involve any bone, usually up to the age of twenty but sometimes in older individuals. It commonly involves the shaft, never primarily the epiphysis, and may metastasize to other bones late in the disease. In the roentgenogram the shaft of the bone appears widened and there is an appearance of a parallel layer or layers of new bone raising the periosteum. Histologically, the tumor contains small round cells with dense nuclei and scanty cytoplasm, simulating somewhat a lymphosarcoma. Deep irradiation is useful and may produce an arrest and healing of the tumor.

Multiple myeloma is a tumor commonly found as a single punched-out area in a rib, vertebra, or the upper part of the femur in individuals from fifty to sixty years of age. The disease is progressive and in the course of time more areas of bone destruction are found. Bence-Jones bodies are present in the urine in a high percentage of cases.

Deep irradiation over the punched-out areas may produce healing, and the life of the patient may be prolonged for a number of years.

Metastatic carcinoma of bone is so familiar to all that I do not want to dwell long on it, except to call attention to the value of deep irradiation. The life of some patients may be prolonged as much as five years by irradiation. This was the experience of one of our patients who was treated at intervals during this time over the involved areas. She was practically free from pain, obviating the use of narcotics, and lived in relative comfort.

Xanthoma, or the Schuller-Christian disease, discussed so ably by Dr. Smith¹ this morning, is not very common. It is a disease of childhood or young adulthood, chiefly involving the skull or long bones. As seen on the roentgenogram the lesion has a punched-out appearance not unlike that sometimes seen in Ewing's tumor. Microscopically, many types of cells may be found, particularly large phagocytes and a type of cell resembling the Dorothy Reed cells found in Hodgkin's disease. Sections may contain lymphoid tissue, large eosinophils and foam cells. Roentgen therapy is valuable and frequently heals the lesion.

I want to emphasize a point made by Dr. Mitchell on myositis ossificans. He had a slide showing a child with deposit of new bone in muscle tissue. I had a patient some years ago, a decorator who accidentally struck his shoulder. About three weeks after the accident I saw him. On the roentgenogram there was quite a deposit of new bone in the soft structures overlying the head and upper end of the humerus. The surgeon who referred the patient was not familiar with the rapid growth of new bone and was ready to go in and remove it. We cautioned him that it would recur very rapidly if he attempted to excise this new bone in the formative stage, and had him wait a month. It turned out to be a compensation case, the surgeon was insistent on operating and trying to get the patient well.

¹ Dr. Lester A. Smith's paper was published in May, 1935, p. 521, which see.

quickly, and against our advice did go in and remove the new bone. Within six weeks there was more new bone reformed than original new bone he had removed and in a year malignant changes had taken place. A few months later metastasis to the lungs occurred, in other words, sarcoma developed and the patient died. Had the surgeon left the case alone, we believe the condition would have remained quiescent and the patient remained well. In certain cases it is well to know that surgery at the wrong time may do considerable harm.

DR WILLIS C CAMPBELL (Memphis) Dr Smith has given us a most comprehensive discussion on those diseases (as Schuller-Christian's) in which xanthoma occurs. My experience is limited to this metabolic reaction as it occurs in xanthoma of joints, tendons, the ends of the fingers, and as associated with giant-cell tumor of bone. The cells in these tumors undergo xanthomatous changes, probably by some inherent biochemical phenomenon, and are not due to a general metabolic imbalance, as complete local removal effects a perfect cure in a high percentage of cases.

Primary bone tumors should be classified as follows: (1) osteogenic, those derived from some of the elements found in the evolutionary process of bone production, (2) non-osteogenic, tissues residing in bone as marrow cells and blood vessels which do not possess the power of producing bone or any deviation therefrom. Dr Phillips says that undifferentiated connective tissue may produce bone and there is not much distinction from an embryologic standpoint. I do believe that, practically, we can usually make the distinction between osteogenic and non-osteogenic. The diagnosis in bone tumors is accomplished by (1) an accurate history, (2) physical examination, (3) roentgenogram, (4) biopsy, and (5) by x-ray therapy.

Ewing's tumor, or endothelial myeloma, is of sufficient frequency to warrant discussion on this occasion. Dr Mitchell has mentioned this tumor. I have analyzed 17 cases as published recently in the "Journal

of Bone and Joint Surgery." I believe that there are three distinct stages of Ewing's tumor as demonstrated by the roentgenogram. First, there may be only condensation or increased density in the shaft. The second stage shows the characteristic expansion of the shaft, with proliferation of the periosteum in so-called strata or layers, that is almost pathognomonic. The third stage shows complete disintegration, with marked lipping or elevation of the periosteum and bony outgrowth at the junction of the tumor with the apparently normal shaft.

In the case demonstrating the second stage an erroneous diagnosis of osteomyelitis was first made which could have been avoided if attention had been given to a complete history. In the case illustrating the third stage there was a complete local regression following x-ray treatment by Dr Rutledge, of Shreveport, La. As Ewing's tumor is highly radiosensitive, this case also illustrates the value of x-ray therapy as a diagnostic measure. This case remained apparently cured for a period of four and one-half years, when death occurred from metastasis.

The case illustrating the first stage which received x-ray treatment and Coley toxins, is now living and well after five years. Coley and Meyerding each report a similar case, with the same form of treatment and the same excellent results. No positive conclusion can be made from such a small number of cases, yet these results are worthy of consideration as they were secured without the sacrifice of the limb.

Trauma as a causative agent is not always present but is quite definite in a case operated on yesterday. This man, aged 30 years, dropped a heavy weight on the instep of the right foot about three months previously. This was followed by immediate pain, swelling and disability that has continued to the present time. On examination three months ago there was a hard indurated swelling over the first metatarsal bone of the right foot which was thought to be an unusual reaction to trauma, as there was extensive bone atrophy or osteoporosis

throughout the bones of the foot and leg. A cast was applied which permitted weight-bearing. After two months there was some local improvement but the tumor persisted. Exploration was decided upon and an osteogenic sarcoma was found. The entire first metatarsal bone with the tumor was excised. As tumors of the metatarsal bones are usually not malignant, further consultation is being had before deciding on future treatment.

Biopsy is attended with very little danger and should be routinely made. The report of any case from the roentgenogram alone is not worthy of consideration as conclusive, scientific evidence. Unless the pathologist has had special training in this field, the report so obtained is without value.

Some progress has undoubtedly been made in recent years, as evidenced by the results. In our clinic there are 11 cases living following amputation and two others following excision, x-ray, and Coley toxins, as compared to no living cases about fifteen years ago. Malignant tumors of bone are an even more serious problem than other forms of cancer, but if the same effort is given to the eradication of pre-malignant conditions and early diagnosis as is given to cancer, it is conceivable that even better results may be attained and much progress made in the treatment of primary malignant bone tumors.

DR. M. L. PINDELL (Los Angeles): I would like to ask Dr. Mitchell and Dr. Campbell what percentage of their cases of osteogenic imperfecta they have found to be hereditary. Some authors think that heredity plays a big part, while others do not. How many cases have you studied?

DR. MITCHELL (closing): We have not had more than four or five. I have nothing to add except to answer the Doctor's question. Our cases have not given a definite family history of the disease in other members of the family—the preceding generations. The condition, however, is stated in the literature to be an hereditary one.

DR. CAMPBELL: May I answer that question? It is a type of case with the blue sclera which is hereditary. There are two types—those with the blue sclera and those that have not the blue sclera. I cannot recall that any of our cases have had the blue sclera, but that particular type is hereditary, while the other is not.

DR. LESTER A. SMITH (closing): The question was just now put to me as to whether or not pathologic fractures occur in any of these states of xanthomatosis. Such pathologic fractures do occur. They have been reported in both Gaucher's and Schuller-Christian's diseases as evidenced by a collapse of a vertebral body or by a fracture of a long bone.

A MODIFICATION OF THE RADIATION TREATMENT OF CARCINOMA OF THE STOMACH¹

By IRA I. KAPLAN, B S , M D , *New York City*

Director, Radiation Therapy Department, Bellevue Hospital

CANCER of the stomach is the most frequently occurring malignancy in human beings (1), constituting 25 to 40 per cent of all cancers. In a review (2) of 1,000 cancer cases referred during 1931-1932 to the New York City Cancer Hospital, approximately 9 per cent were cancer of the stomach, this number was exceeded only by that of cervix and breast cancers. Unfortunately, in only about 10 per cent of all stomach cancer cases is the disease recognized in the early stages.

A study of 37 cases of stomach malignancy autopsied at the New York City Cancer Hospital during 1929-1934 disclosed that in nine cases only was any form of operation possible before death, the others showing markedly advanced gastric lesions already present at the time the patients came to the Cancer Hospital.

The futility of the usual efforts to relieve cancer in stomach conditions, especially in advanced stages, prompted us to attempt a new form of therapy. By the use of radiation we are enabled to transform a totally hopeless condition into one in which some measure of aid can be given, the patient's suffering being alleviated and his life prolonged, with at least some degree of comfort. Hitherto in cases of hopeless involved carcinoma of the stomach, therapy of one form or another has consisted in giving sufficient opiates to relieve the severity of the pain. The surgical mortality in the more advanced cases is extremely high,

and the results, even in those seen early, are by no means encouraging (3, 4, and 5). By itself, roentgen-ray radiation through the intact abdominal wall has offered not more than moderate palliative relief in some cases (6 and 7).

With the idea, therefore, of doing something more direct in the radiation attack on this lesion, we endeavored first to radiate the lesion directly with the x-rays, which has been attempted by others (8 and 9). For this purpose a method combining surgery and x-ray therapy was planned. The patient was prepared as is customary for surgical operation, a preliminary jejunostomy was done, the stomach drawn into the abdominal wound, and high voltage x-rays projected directly through a lead glass cone on the lesion.

The factors used in this method of irradiation were 200 K V , 4 ma , 50 cm distance, 6 cm portal, filtration 0.5 mm copper and 1 mm aluminum, 100 per cent dose being administered at one time.

In four cases treated by this method, only one recovered sufficiently to move about, one succumbed the day following treatment, the second after an interval of a month, and the third after three months. For a time no further attempts were made with this method of treatment.

Direct irradiation of carcinoma of the stomach with radium has already been used with various degrees of success (10 and 11). Applications to the lesion have also been effected by introducing radium tubes into the stomach, various ingenious devices being employed in these efforts to apply the radium directly to the newgrowth. In a number of instances radium packs (12) were applied to the abdominal wall. Some workers attempted direct apposition of radium plaques through surgical openings in the stomach, but none of these were altogether successful, probably because they

¹ Because of changes in the organization of the service further work along these lines was not carried out. However, since subsequent experience over the past several years has produced no improvement in treating stomach cancer by other standard methods that have been tried, we deem it not inadvisable to revive this method of irradiation. The following paper was prepared for publication in 1928, but even to-day the plan as then devised and with certain modifications is still applicable. This work was carried out in conjunction with Dr. Robert P. Wadhams of the Third Surgical Division, Bellevue Hospital.

attacked the tumor lesion extra-murally and delivered a large dose of irradiation over a short period of time

therein of suitably prepared, filtered radon seeds. The number of seeds and the strength of the radon in each varies with



Fig 1 Case 1



Fig 2 Case 2

With the advent of a better technic in the use of radium emanation, that is, the use of filtered seeds in more or less inaccessible lesions heretofore not treated by radium puncture, we believed we had found, perhaps, a feasible method of attacking those malignancies of the stomach which before had not been amenable to treatment.

This method, employed in conjunction with surgery, alleviates the immediate distress in these cases and slowly attacks the malignancy itself. With this procedure, too, there is the possibility that a lesion, previously thought inoperable, will become so reduced in size that surgical intervention for removal of the primary lesion may be considered.

The technic is not at all complicated, and consists of a preliminary gastro-enterotomy, followed by the delivery of the stomach into the abdominal wound, localization of the lesion, and implantation

the extent of the lesion. In the three cases herewith reported, from 20 to 40 gold seeds were used, containing approximately 1 millicurie of radon in each seed. The seeds were implanted in the part of the stomach wall involved by the tumor, and were placed in parallel lines up to, but not puncturing through, the mucosa of the stomach. Seeds were also placed in all palpable accessible lymph nodes located in the vicinity of the stomach. The gold filtration of 0.3 mm absorbs approximately 95 per cent of the beta rays, thereby to a large extent avoiding localized necrosis. Following the radon implantation, the abdominal wound is closed in the usual surgical manner. The next day the patient may be put on a nourishing soft diet, and in a short time allowed up and about.

A few days following the healing of the abdominal wound, high voltage x-rays are directed to the stomach lesion, anteriorly and posteriorly through the abdominal

wall In this way additional radiation over a more extensive area is delivered to the tumor and surrounding tissues

In carcinoma of the stomach, the pylorus is the most frequent site of the lesion Of the three cases herewith reported, two were pyloric tumors, and the third involved nearly the entire stomach, presenting the so-called "leather-bottle type" The result in two cases was good, and bad in the third The two patients were alive and comfortable, one five months and one after two years the third patient, with the leather-bottle type stomach, died two months after treatment, having been bed-ridden continuously following treatment

CASE REPORTS

Case 1 Mr W B , aged 61 years, single, a German farmhand, was admitted on July 26, 1927, complaining of a pain across his abdomen, dizzy spells, and black spots before his eyes His family history revealed that his mother had died of old age, his father had died of tuberculosis, and one brother had died at the age of 30, cause unknown The patient himself had a chancre at 18 years of age Gonorrhea twice, about 42 years ago Wassermann was negative He had been in good health until July 5, 1927, when he experienced dizzy spells, with black spots before the eyes and pain across the abdomen on the first day Stools from onset were watery For four days before admission to the hospital, he would awake at night with profuse watery vinegar-like vomitus, he had none during the day

A gastro-intestinal series showed carcinoma of the pars pyloris Two-thirds of the meal remained as residue after six hours On examination, a definite hard irregular mass was felt on expansion to the right of the median line, and about 10 centimeters below the umbilicus Free HCl, 0 lactic acid, positive

On Aug 22, 1927, the patient was given a 55 c c blood transfusion On Aug 23, 1927, he was taken to the operating room where a gastro-enterostomy was done, and



Fig 3 Case 2 Postmortem stomach the x-ray showing radon seeds in wall

radium was implanted (15 gold seeds, 21 20 millicuries) A gland was removed and the pathologic report showed metastatic adenocarcinoma Following operation, the patient did well and was up and about after one week Pain and vomiting were relieved He has been coming regularly for x-ray treatment

On Nov 19, 1929, he reported to the hospital in fair condition, with some gastric distress He has not reported since then (The patient has been alive and in fair condition for nearly two years)

Case 2 Mr J R , aged 62 years, a widower, was admitted on Aug 31, 1927, complaining of a pain in the left abdomen His family and past histories were negative The onset of symptoms began three months ago, with pain in the left upper abdomen, which increased steadily and was aggra-

attacked the tumor lesion extra-murally and delivered a large dose of irradiation over a short period of time

therein of suitably prepared, filtered radon seeds. The number of seeds and the strength of the radon in each varies with



Fig 1 Case 1



Fig 2 Case 2

With the advent of a better technic in the use of radium emanation, that is, the use of filtered seeds in more or less inaccessible lesions heretofore not treated by radium puncture, we believed we had found, perhaps, a feasible method of attacking those malignancies of the stomach which before had not been amenable to treatment.

This method, employed in conjunction with surgery, alleviates the immediate distress in these cases and slowly attacks the malignancy itself. With this procedure, too, there is the possibility that a lesion, previously thought inoperable, will become so reduced in size that surgical intervention for removal of the primary lesion may be considered.

The technic is not at all complicated, and consists of a preliminary gastro-enterostomy, followed by the delivery of the stomach into the abdominal wound, localization of the lesion, and implantation

the extent of the lesion. In the three cases herewith reported, from 20 to 40 gold seeds were used, containing approximately 1 millicurie of radon in each seed. The seeds were implanted in the part of the stomach wall involved by the tumor, and were placed in parallel lines up to, but not puncturing through, the mucosa of the stomach. Seeds were also placed in all palpable accessible lymph nodes located in the vicinity of the stomach. The gold filtration of 0.3 mm absorbs approximately 95 per cent of the beta rays, thereby to a large extent avoiding localized necrosis. Following the radon implantation, the abdominal wound is closed in the usual surgical manner. The next day the patient may be put on a nourishing soft diet, and in a short time allowed up and about.

A few days following the healing of the abdominal wound, high voltage x-rays are directed to the stomach lesion, anteriorly and posteriorly through the abdominal

PRELIMINARY OR PRE-OPERATIVE AND PRE-RADIUM IRRADIATION IN THE MANAGEMENT OF MALIGNANT DISEASES¹

By J THOMPSON STEVENS, M D , *New York City and Montclair, N J*

BLOODGOOD (1) states "My most recent experience convinces me that one should think of using irradiation with x-ray or radium before rather than after operation. It must be given a thorough trial. At the present time the majority of authorities, I think, take too little time in pre-operative irradiation. Properly done, it does not interfere with healing. I have not had any interference with healing after operation when there has been pre-operative irradiation to the breast." It is felt that you will agree that here is certainly food for thought. Can it be that those of us who have advised pre-operative and pre-radium irradiation in the management of malignancies, from the earliest days, are actually going to live to see it adopted by our foremost neoplasticians? Bloodgood's unique position as a master surgeon and a surgical pathologist of international reputation, with many years of service in a great medical institution, especially qualifies him to speak with the utmost authority, because he has had an almost unlimited experience in the management of malignant neoplasms by all of the accepted procedures known today. Therefore, anyone who treats malignant diseases should, without further delay, at least acquaint himself with the data that are accumulating in medical literature favoring pre-operative and pre-radium irradiation.

Ewing (2) states "In general, radiated cancer tissue shows degeneration, necrosis, and atrophy of tumor cells, followed by cicatrization. This process is marked by peculiar swelling, liquefaction of cell cytoplasm, swelling, and hyperchromatism of cell nuclei, followed by disintegration of the cells. It is usually attended by marked hyperemia and lymphocytic or leukocytic or plasma

cell exudate. The effects are produced partly by action on the tumor cells, and probably more by action on the blood vessels. The acute degenerative stage is followed by various types of cicatrization. In imperfectly radiated tissue, some tumor cells often persist in a condition known as abortive fibrosis, from which recurrences may develop. All stages of partial or complete destruction of tumor cells are commonly found at various stages of radiation reaction, and the progress of events varies greatly, depending on the strength of the dosage. The very numerous important details of the process of radiation reaction cover an extensive field, upon which there is voluminous literature." In other words, *properly* irradiated malignant cells are devitalized. Such devitalized cells will not grow or produce metastatic newgrowths when transplanted by the manipulation which always accompanies any operative procedure, or when radiation doses are too small to completely destroy their cells, their vitality is so depressed that recurrence and metastatic lesions appear with lessened rapidity, *i e* , they have difficulty in reproducing themselves. Cowell and Russ, in *Radium and X-rays and the Living Cell*, record their experiments which prove that all of the effects just mentioned are not fancy but actual fact.

Pfahler (3), more than twelve years ago, published a paper which dealt with the problem of preliminary or pre-operative irradiation. This was one of the earliest papers advising such treatment, and it is here that the details of this method of treatment were laid down, many of which are being adopted or are being followed by our foremost neoplastic clinics throughout the world. Pfahler was probably the first to use and advise this preliminary irradiation, and at that time described it under "ante-operative" irradiation. In Pfahler's hands,

¹ Presented before the Radiological Society of North America at the Twentieth Annual Meeting, at Memphis, Tenn, Dec 3-7 1934

vated by food. He had not taken solid food for three months.

On Aug 23, 1927, an x-ray examination showed the stomach markedly diminished in size, with complete absence of peristalsis of both lesser and greater curvatures of the pars cardia and media. The diagnosis was diffuse cancer of the stomach.

Physical examination showed an irregular hard tender mass, 2 X 1 in., in the epigastrium just under the costal margin on the left. Wassermann was negative. Gastric analysis blood, positive. No free HCl, lactic acid, positive.

On Aug 31, 1927, an operation under general anesthesia was performed, a jejunostomy, followed by radon (40 seeds implanted, gold filtered, 1 millicurie each). A pathologic report of the gland removed was metastatic carcinoma. The subsequent history revealed that the patient did poorly following operation and remained bed-ridden until the time of death, which occurred Nov 3, 1927.

Postmortem examination showed the stomach to be hard, leathery, nodular, non-flexible, and to cut with difficulty. The mucous lining was completely replaced by fibrous tissue (Fig 3). No necrosis.

Case 3. Mr G. A., aged 30 years, a white, Russian cook, was admitted Sept 19, 1927, complaining of vomiting and inability to retain food. His family history was negative. The patient had had measles in childhood, no adult illness.

At the time of admission the patient was emaciated, having lost 22 pounds in the three months since the onset. He had sub-sternal pain following the taking of each meal, relieved upon vomiting food from 13 to 20 hours afterward, there never was any blood in the vomitus. He had had cough and dyspnea since the onset of the condition, but no difficulty in swallowing. The pylorus was irregular.

A gastro-intestinal series revealed that at the end of six hours three-fourths of the meal remained as residue. A diagnosis of organic pyloric obstruction was made. Physical examination showed that there

was no visible or palpable mass in the abdomen. The patient looked years older than his actual age. Vomitus was never projectile, never bloody, but coffee-colored. Stools were normal in color. Wassermann was negative. Gastric analysis blood, positive. Free HCl, lactic acid, positive.

On Oct 19, 1927, under general anesthesia, a post-gastro-enterostomy was done and 32 gold-filtered seeds of radon implanted in the wall of the stomach in and around the tumor mass. The patient returned to the ward in good condition. Following treatment, he was markedly relieved of most of his symptoms, but still had some pain. In two weeks he was up and about the ward, and was reporting regularly for x-ray treatment.

In February, 1928, the patient began to do poorly and died on March 2, 1928, from cachexia. (He had been alive and well for five months.)

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slight swelling of the tumor itself. When there is hypertrophy of the glands in the axilla, a definite decrease in size of these metastatic lesions is to be expected to accompany preliminary irradiation, and when the breast is broken down, these glands will occasionally disappear entirely. In cases in which the glands do disappear completely during preliminary irradiation, it may be concluded that they were inflammatory in origin rather than malignant metastases. In cases characterized by fixation of the tumor and the breast to the chest wall, or fixation of the tumor to the overlying skin, or both, preliminary irradiation will sometimes change the entire clinical picture, and if the tumor happens to fall into the radio-sensitive groups, the tumor may become more or less movable within its bed, *i e*, the disease is becoming localized. In cases in which pain is a prominent symptom, it diminishes and sometimes disappears entirely.

Often even in the most desperate cases of carcinoma of the uterine cervix, there is a marked change in the clinical condition of the patient. She is generally happier and has a more optimistic outlook, because usually the hemorrhages have disappeared, sometimes, even, there is no bloody streaking, discharge has decreased, and not infrequently all pain has disappeared. Conditions, in general, are almost always much improved and the patient comes up for local treatment not later than one week following the last day of the preliminary roentgen treatment.

Examination often shows an improved local condition even at this early date, cases that have had the most evidence of infection associated with the malignancy showing the most striking results. Not infrequently a new growth that appeared to involve the cervix, with extensions to other parts, has receded so that only the cervix is actually involved. The malignant extensions of the disease would seem not to have been actual, in such an instance, but proved to be only the products of an extensive pelvic infection grafted onto the malignancy. The malignant tissue itself may also show

the effect of the treatments in that it may not bleed so easily. The field can be kept comparatively free from blood, and under such conditions a more accurate and efficient local radium treatment can be carried out by the operator.

In cases of carcinoma of the urinary bladder, frequently following preliminary roentgen irradiation, there is a marked improvement in the patient's general condition, especially in cases suffering with severe hemorrhage and secondary infection. Bleeding is controlled, often within twenty-four hours after treatment is begun. Aside from the benefit that the patient experiences from this alone, there is the fact that further cystoscopic studies can be made much more valuable because the vision of the examiner is not clouded with blood, and he is, therefore, able better to define the extent of the involvement. Urinary sediment, pus cells, and debris, *i e*, products of chronic infection, lessen and in some cases entirely disappear. Because of this the temperature is lowered and will sometimes reach normal within a few days, or before preliminary treatment is completed. In a considerable percentage of cases there will appear multiple implantations in the wall of the bladder following operation. Preliminary irradiation reduces these to a minimum, because irradiated cancer cells either do not grow at all when transplanted or grow with difficulty. Furthermore, while giving these treatments, sufficient time passes to permit of careful study and treatment of the patient's other vital organs, it is felt, therefore, that no valuable time has been lost or wasted because of this preliminary or pre-operative roentgen irradiation.

In conclusion, too frequently advanced and hopeless cases are the only ones given the benefit of irradiation. While these cases are often given excellent palliation, and occasionally a case of this type will survive for five years and longer, however, in these groups one must be prepared to accept ultimate failure in the vast majority of instances. Because of these facts, it is felt that the cases of malignancy presenting

preliminary irradiation had a more or less thorough trial prior to the appearance of the above paper for, as he says therein, "Therefore, since those clinical observations and experimental investigations show a devitalizing effect upon malignant cells, we are justified in recommending that the rays be used for this purpose preceding operation, as I have been doing for a number of years "

For a number of years your essayist has stressed the value of pre-operative and pre-radium irradiation, and in several definite papers has included data showing that this plan of management is of greater palliative and curative value than is follow-up radiotherapy. None of this material will be reviewed here for obvious reasons, but at the end of this paper several references are added, thus making it easy for anyone who may be interested to look it up.

When a patient presents himself for examination with a tumor in which a surgical operation would seem advisable, let none of us ever be guilty of withholding that operation, but in the light of present-day knowledge, each of us should insist upon thorough preliminary irradiation, not only of the actual newgrowth but of the various regions in the immediate neighborhood. Whenever possible, insist upon this preliminary irradiation, even when the mass seems absolutely localized and there is no evidence of metastasis either locally or generally. Given a patient in whom operation seems contraindicated, preliminary irradiation would seem indicated before localized efforts are made to eradicate the disease by radium. Certainly radium implantation into a mass of viable cancer cells would seem as likely as operative procedures to produce mechanical metastasis, for while radium is being placed within the mass, the tumor must be held, squeezed, manipulated, and in all ways traumatized. Probably the most important reason for having such faith in preliminary irradiation is the fact that in the vast majority of patients who present themselves for advice and treatment, one can be reasonably sure of the exact location of all of the malignant cells, *i e*, within the tu-

mor. Treatment at this time, then, irradiates *all* of the disease, whereas, after operation or radium implantation, no one can ever be sure of the exact location of all of the disease, except that it is distributed somewhere within the patient's body. The higher percentage of recurrences and often distant metastatic lesions which follow in cases not having preliminary irradiation, would seem to prove these statements.

Preliminary irradiation does not affect the general condition of the patient adversely, so that treatment may be given with no fear of increasing the hazard of subsequent procedures.

Because of the adaptability of the roentgen rays, they are generally used exclusively for preliminary irradiation. The focus-skin distance, filter, voltage, number of ports of entry, and dosage must, of course, be varied to meet the physical conditions indicated by the location of the disease, whether it is at or near the surface of the body, as in carcinoma of the breast, or in the depths, as in carcinoma of the uterine cervix and urinary bladder. The preliminary roentgen treatments are so planned that they will be completed within two weeks' time, with not more than from eight to ten days actually consumed in the treatments. Generally, in this two weeks of preliminary roentgen treatment, each port of entry is treated twice. With such a scheme of division of dosage, it is perfectly safe to allow the total preliminary roentgen-ray dosage to be increased by 50 per cent to each port of entry, *i e*, give to each port of entry 75 per cent of the maximum safe dose twice within two weeks, thus bringing the total dosage even up to 150 per cent to each port of entry.

Clinically, in the early cases of malignant tumors of the breast, while the disease is still localized to a single primary mass within the breast, radiation reactions are not always typical. Sometimes a distinct reduction in the size of the mass is noted during the two weeks of preliminary irradiation, but more often the reaction is characterized by some swelling of the entire gland, together with softening and some

A SIMPLIFIED METHOD OF BRONCHOGRAPHY¹

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SINCE the year 1921, when we succeeded for the first time in visualizing the bronchial tree of the human with lipiodol with no untoward result for the patient, bronchography has extended its field yearly. It has proved to be helpful in a number of pulmonary diseases in which changes in the bronchial tubes may exist, but, even after thirteen years we feel that the whole field of bronchography has not been covered, and that added information can be obtained from improved technics and better interpretations of roentgenograms.

For several years we have used the transglottic method for the injection of opaque oil, injecting the oil by means of a long metallic catheter introduced directly into the trachea, after local anesthesia of the pharynx and larynx and under the control of the laryngeal mirror. One important feature in our technic has been the introduction of the intratracheal anesthesia previous to the injection of iodized oil. The principles which we established twelve years ago have been accepted almost unanimously.

The success of an injection of iodized oil into the bronchial tree depends upon the control of the cough. The latter can be controlled only by injecting a local anesthetic—cocaine, novocaine, or any similar compound—into the trachea itself before injecting the opaque oil. This anesthesia may not be necessary in therapeutic injections of small quantities of iodized oil in patients who have been trained to this particular technic, but it is necessary for diagnostic injections of large quantities of iodized oil in patients who experience such an injection for the first time.

We have always felt that the use and benefits of bronchography could be widely extended if there was a simplified method

of injection which would enable any qualified physician to perform it without the additional help of one or more specialists. The simplified methods of J. J. Singer, of St. Louis, and of A. Ochsner, of New Orleans, have already rendered great services along these lines. They do not require the use of the laryngeal mirror, and the local anesthesia is easy to accomplish, yet many physicians have experienced some difficulty in obtaining a high percentage of successful results. Further improvement in technic is desirable.

THE PERNASAL METHOD

The method which we describe in this article is a derivative of that proposed by Hicquet and Hennebert, of Brussels. These authors proposed to inject the oil into the bronchial tree with a soft rubber catheter introduced into the nostril and further down into the pharynx, larynx, and trachea. We found that the same route could be followed without the use of any catheter, the oil, and, previously to it, the anesthetic, being injected directly into one nostril with an ordinary glass syringe exclusive of any tip or catheter of any sort. This method has been worked out with the help of our associate, Elisabeth Kudelski, at Hôpital Cochin, during the past two years. It has proved to be efficient in more than 90 per cent of the cases, and has been demonstrated in several hospitals or clinics in the United States during the recent visit of one of us (J. F.).

PRINCIPLES OF THE METHOD

The method is based on two principles.

(1) When the tongue is pulled out of the mouth and grasped firmly, the epiglottis is raised with the whole larynx, the upper orifice of the esophagus is closed, and the

¹ Presented before the Radiological Society of North America, at Memphis, Tenn., Dec. 3-7, 1934.

themselves with the primary tumor should be given more complete and thorough treatment than is the rule to-day, because these are the cases that are going to give the majority of good end-results. Therefore, in these early cases, even though the disease is only manifested by a primary single tumor, let us encourage pre-operative and pre-radium irradiation. If the tumor proves to be benign, histologically, no harm has been done by the preliminary irradiation, and no post-operative irradiation is indicated. But should the tumor prove malignant upon histologic examination, treatment should be completed with thorough, skillful post-operative irradiation.

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DISCUSSION

DR W. S. LAWRENCE (Memphis). Speaking on Dr Stevens' paper, of course one practical trouble in pre-operative treatment of cancer of the breast is that one is liable to do so much good, and produce so much apparent improvement, and bring about nearly a cure that one of two things may happen. First, the surgeon may lose the case that he sent you—lose control of it, second, the woman may refuse to be operated on, although you may plead with her, scare her, caution her, everything you like. Sometimes she will quit you because you talk too much about operation. That is one practical point that comes into the concrete procedure or militates against the correct procedure in the irradiation of breast tumors.

dilution All fluids injected are previously heated to body temperature

PERFORMANCE OF THE INJECTION

The performance of the injection con-

5 or 10 seconds, at this moment, when the fluid has slipped over the palate into the pharynx and then into the larynx, the glottis, by a reflex, closes itself immediately The patient remains a few seconds in apnea,



Fig 2 Parnas method Anesthesia of the larynx Patient in sitting position



Fig 3 Parnas method Position of the patient immediately after anesthetic has been injected

sists of the following two phases (1) local anesthesia, (2) injection of opaque oil

1 *Local Anesthesia*—In most cases it seems preferable, previous to the performance of bronchography, to give the patient one or two hours previously some form of sedative medicine—a small dose of chloral or luminal In highly nervous patients a small quantity of morphine may be injected

For the anesthesia, the patient must be in the sitting position, resting quietly against the back of a chair, and with the head raised at an angle of 45° (Fig 2) We used to explain to the patient, previous to any maneuver, the different steps of the examination which is to be performed Thus we gain his confidence and beg for his co-operation

The tongue is pulled out of the mouth, held firmly in a piece of gauze with one hand, and the patient is asked to breathe naturally and quietly It may be wise to protect the tongue from being eroded by the lower teeth by inserting a few layers of gauze between the latter and the lower aspect of the tongue

(A) The first dose of 5 c c of the anesthetic solution is injected into one nostril in

at which moment it is essential to hold the tongue very firmly or otherwise deglutition will take place (Fig 3) The patient upon being asked to breathe, will then open his glottis, the fluid will penetrate into the *trachea*, while a typical aspirating sound will be heard and a violent coughing fit will follow When this fit is over, the tongue is released and the patient is allowed to expectorate a part of the anesthetic solution

(B) Five minutes later, a second injection of 5 c c of the anesthetic solution is made with exactly the same technic Generally it does not produce immediate cough, the fluid sliding down directly into the *trachea*, but when it reaches a bifurcation, a delayed fit of coughing appears, of lesser intensity than with the first injection

(C) Five minutes later, *i e*, ten minutes after the first injection, a third injection of 5 c c of anesthetic solution is made In most cases it brings about hardly any cough reflex, and it is the check that anesthesia has proceeded favorably In very sensitive patients, a fourth injection of cocaine may be required, but this is an exception It is recommended that the last anesthetic injection should be made in the

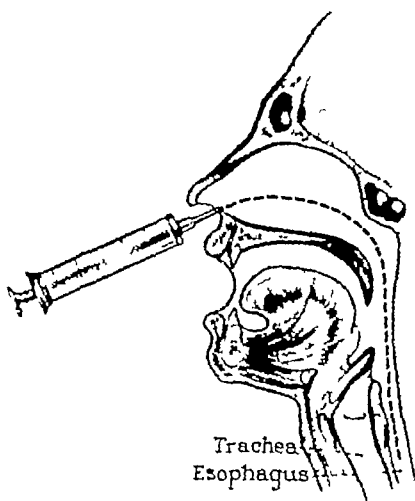


Fig 1-A

Fig 1 Pernasal method. A diagram demonstrating the action of the pulling of the tongue after an injection of fluid into the nostril. (A) When the tongue remains in the mouth the esophagus is open and the fluid is swallowed. (B) When the tongue is pulled firmly out of the mouth the epiglottis is raised with the larynx, and deglutition cannot take place. The only possible way down offered to the fluid is the glottis.

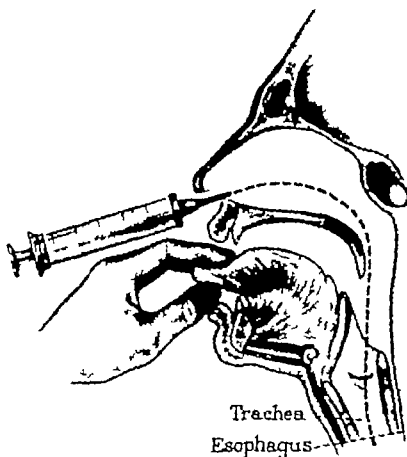


Fig 1 B

patient is unable to swallow. This is, incidentally, the position for the examination with the laryngeal mirror. If any fluid comes into the pharynx in this position, the only way open below is the glottis (Figs 1-A and 1-B).

Of course, such fluid can be injected directly at the base of the tongue with a short curved metallic catheter, but with this technic the fluid falls down briskly from a height of one or two inches against the pharyngeal mucosa, and is more apt to bring about some cough reflex than if it slides gently down, coming from the nose along the pharyngeal wall.

(2) The local anesthesia of the pharynx, larynx, and trachea is made with exactly the same technic as the injection of iodized oil itself. The anesthetic solution is poured into the nostril and slides down to the glottis and later into the trachea, following exactly the same path which the oil will follow when bronchography is performed. Thus no laryngeal mirror, swab, or spray are necessary, and the technic can be performed by any qualified physician. It seems probable that the local anesthesia brought about by the cocaine solution on the nasal and pharyngeal mucous mem-

branes helps to stop the cough reflex arising in the laryngeal vestibule. We know the favorable action of the local anesthesia of the lower meatus on trismus, and experience has proved that anesthesia performed through the pernasal route is more effective than by direct spray on the glottis.

Once the anesthesia of the larynx has been obtained, it will be necessary to anesthetize the tracheal bifurcation by injecting some more anesthetic, to penetrate into the bronchial tubes.

INSTRUMENTS AND SOLUTIONS

The instruments are as simple as possible, consisting of one 5 c c glass syringe for local anesthesia, and of one 20 c c glass syringe for the injection of opaque oil.

The anesthetic solution which we have used is made according to the following formula:

Cocaine hydrochloride	2.00 gram
Potassium sulphate	0.60 gram
Phenol	0.20 gram
Adrenalin chloride solution (1-1,000)	10.00 c c
Cherry laurel water	40.00 c c
Distilled water	q s 150.00 c c

We generally use the 40 per cent concentration of lipiodol without any mixture or

bronchography has been helpful mostly for the study of the bronchial tree and not so much for that of the pulmonary parenchyma, it seems desirable that the film should be taken at the moment when the primary subsequent divisions of the bronchial tree are mapped out at their best. A careful study of the transit of opaque oil into the normal bronchial tree has been made by Mounier-Kuhn, who has described the following four phases

(A) Transit through the trachea and the main bronchi. It lasts just a few seconds.

(B) Mapping out of the lobar bronchus. It lasts a few seconds more, and a film taken at that time shows exclusively the trachea and the main trunks, this view has been described as that of a "winter tree."

(C) Under the combined influence of respiratory movements and the injection of a further quantity of opaque oil, the mapping out of the smaller divisions of the bronchial tree takes place. This is the view described as the "spring tree." Such a view is obtained within three or four minutes after the beginning of the injection, and remains during three to five minutes more, when the last phase appears.

(D) The pulmonary alveoli are being filled through the influence of respiratory movements and absorption of residual air. The "foliage" is then visible, we have the view of the "summer tree." In that phase, the innumerable small shadows of the pulmonary alveoli overshadow the outlines of the bronchial tree, and such a picture is much more difficult of interpretation.

It has been our experience that the best moment to obtain a good visualization of the main bronchi and their further divisions is, as a rule, between three and five minutes after the beginning of the injection.

During the early periods of bronchography, the attention of the physicians has been especially drawn to the abnormal images obtained in mapping out the bronchial tree. It seems that the moment has come when the interest of this exploration

on the anatomic changes, but also on the functional defects of the bronchial tree. Experience has shown that, previous to the appearance of the abnormal shadows in a diseased bronchial tree, it was possible to detect those functional defects which express themselves in the delay of transit of the iodized oil.²

One of us has shown that in certain patients, who had been submitted to toxic gas during the War, the only perceptible radiologic change in the bronchial tree was a very important delay in the progress of the oil into the smaller divisions of the bronchi. The persistence of the picture in the form of a spring tree, ten or twenty minutes after the injection, is a definite proof that the peristalsis of the bronchial tree is impaired, and that there is a want of proper aspiration in the affected area.

For this reason the taking of several films at different intervals after the injection, in order to study the progress of the oil, is indicated.

In our opinion no complete interpretation of the film after bronchography can be made if the following data are not given: (1) Dose and temperature of iodized oil injected, (2) positions of the patient during the injection and during the taking of the roentgenograms, (3) time elapsed since the beginning of the injection. A rule should be made that such data should be provided with every film.

RESULTS OF THE METHOD

The results have been, as a whole, most satisfactory, very few failures having been encountered. Only one person out of several hundred is able to swallow the oil while the tongue is pulled out firmly. This procedure causes the patient as little discomfort as possible.

Fluoroscopy can be performed while the injection of iodized oil is made. We have succeeded in injecting patients with a very

* BONNAMOUR S, and BADOLLE A. Roentgenography of the Normal Lung Following Injection of Lipiodol and the Diagrams of Small Bronchiectasis. Presse Méd. 1929 37, 173-176.

roentgenographic room, since it is desirable that the injection of iodized oil should be made as quickly as possible after it.

2 *Injection of Iodized Oil*—It must be recalled that the distribution of the oil in

be lying on the table, with the head slightly elevated, the corresponding shoulder lying on the table, the opposite shoulder lifted up on cushions which have been slipped behind the back of the patient



Fig 4 Pernasal method Position of the patient for injection of lipiodol into the right base



Fig 5 Pernasal method Position of the patient for injection of lipiodol into the right apex Note the position of the right arm

the bronchial tree depends upon the position of the subject *at the time* of the injection. Gravity is the main factor in the distribution of the oil in the trachea and the main bronchi, but when the oil has reached the smaller divisions, it is kept in the lumen of the bronchial tubes by its high viscosity, and any position taken after the oil has reached these divisions has little influence, if any, upon the distribution of the oil.

We have made a rule to try to map out only one lung at a time, with from 20 to 30 c.c. in one injection. If we want to map out the opposite lung, bronchography can be repeated within a few days, and as the pernasal injection causes the patient the slightest possible discomfort, this procedure is very well accepted by patients.

Keeping these principles in mind, the following positions will be given to the patient, depending upon the area which is to be injected.

Base—The patient must be sitting, slightly inclined on one side. This is the easiest field to reach (Fig 4).

Middle lobe (right lung) or upper part of lower lobe (left lung)—The patient must

Upper lobe—The patient must be lying on one side, the head slightly elevated, the corresponding shoulder pulled out to the edge of the table, the arm being lowered down as much as possible, while the opposite shoulder is lifted as for the middle lobe.

Experience has proved that it is more practical to make injections through the opposite side of the lung to be injected (Fig 5).

ROENTGENOGRAPHIC TECHNIC

It is well to note that, for middle and upper lobes, the injection should be performed, if possible, on the roentgenographic table. There is no objection to performing the injection under fluoroscopic control. It is essential that the first exposure should be taken before there has been any coughing. Co-operation should be asked of the patient, and he should be begged to refrain from coughing at any cost until the films have been taken.

It is a matter of no small importance that the roentgenogram should be taken at the proper time after the injection. Since

medical fields. You may say that such men are not skilled in x-ray diagnosis, but if the radiologists from the large medical centers should take the trouble to investigate, they would find many of these men skilled and better doctors because of their endless search for more knowledge from the film or screen. Watch them pass a cystoscope and examine a bladder, pass ureteral catheters for a functional kidney test and retrograde pyelography, search for red cells and casts under the microscope, or tubercle bacilli from the urine. See them perform an intravenous urography and interpret an electrocardiogram. Aye! watch them treat their patients and, while you are at it, investigate the countryside where the electric current penetrates and find out how many doctors can to-day, within ten minutes, pull a portable x-ray machine out of a motor car and assemble it on the second floor outside a patient's room, to be wheeled in and used at will. To know some of these things and witness the uncanny diagnoses, is to see a young generation of better doctors working and getting somewhere with medicine. For them, there is no mystery about making a film or screening a patient during these days of simplified apparatus. If there still is a mystery about it, then many of these physicians, not members of x-ray societies, seem to be attempting to solve it, and, what is most important, getting somewhere with diagnoses.

In the large cities the gastro-enterologists, urologists, skin specialists, eye-ear-nose-and-throat specialists, orthopedic surgeons, dentists and others are all falling in line in private practice and equipping themselves for their individual needs. As radiologists, we see many of their terrible mistakes, but, as a stepping stone to the ultimate diagnosis, the x-ray is passing rapidly from limited hands to being a tremendous aid in medicine under the numerous well-trained hands of many and diverse eminent specialists in many fields, who know much more concerning their own special field than many radiologists in general diagnosis. True, the limitations of x-ray diagnosis may be such that a general diagnostician in radiology may not be required to know all of the intricate problems of the various special fields. But to stand on the borderland and view but the screen or film, as many a radiologist has found out, is frequently to be standing soon in one's own "no man's land." The advance of radiology by radiologists of the present and

future shall be made by those who are able to see beyond their range of vision of the screen or film, and by specializing within the specialty. The borderland position is occupied by many radiologists to-day and they are worse off than the country radiologist (if you may call him such, as I have described his activities above), for that chap in the country is pushing his investigations beyond the film to the function of the kidney, to the heart, and to metabolism as well, so that he can judge what he personally may do in the complete general care of the case.

Recently I talked with a prominent radiologist concerning the present inducements offered for the young man entering the x-ray field. We agreed concerning a lengthy training and adequate foundation for the work. Our discussion led to the sad situation of the hospital exploiting the radiologist so as to make more money for the institution. He blamed a great deal of it to the perfection of apparatus and to the ease with which a technician these days may perform the radiographic work. That, and the ease with which it is possible to motor rapidly from one hospital to another over good roads, made it perfectly logical to him that a radiologist could easily and adequately attend to the radiological work of several hospitals. Such work is always badly done. He has three city hospitals, none of which are under two hundred and fifty beds each, and one of them is much larger. He works by schedule. I wondered how many times a week this man stood beside the surgeon in the operating room to view the pathology he had declared the surgeon would find, how many times during the week he viewed a post-mortem, saw a tissue slide, examined a heart, read a detailed history, or thoroughly discussed a clinical problem with the referring physician or the specialist in the clinical laboratory. I wondered also what observation and check he was making of his therapy cases.

This good friend of mine is a borderland radiologist and underpaid, possibly because he is a borderland radiologist overworked and dashing about for a living, meeting three hospital schedules and attempting to copy the style of the surgeon whose chief job per patient is a short session in the operating room with resident nurses, and an assistant afterward performing the most of the work as the patient is recovering in bed, a film-reader is not doing justice to himself or his patients and crowding

be controlled and utilized, shall more than fulfill Mr Ford's prophesy, and put him out of the automobile business. The practical control and use of atomic energy within the next twenty-five years would revolutionize everything in this world connected with power. Physicists see the faint hope of accomplishment through radiology. Within the past few months a young physicist, investigating the atom, has perfected a single small million-volt apparatus that bids well to scrap our feeble and expensive deep therapy apparatus of to-day. Shall we have a small tube developed that "can take it?" Perhaps the logical answer may only be in belief as we see it, with a code passed by Congress to keep down the price of machines heretofore held up to the sky by the law of patents.

I recall a conversation a year or two ago with the assistant professor of roentgenology at one of the large eastern universities in which he discoursed at length upon the need for establishing radiology as a pure science in medicine.

The short-sighted economic urge of hospitals to make more money out of the x-ray department at the radiologist's expense and by exploiting him had aroused the professor to the need of such a position for radiology. I was surprised at his lack of vision for the future. It would be no more possible to separate radiology as a pure science in medicine than it would be to divorce medical men from wielding a scalpel, the examination of urine or tissue, or passing a cystoscope. No doubt there are many who feel like the professor, overburdened with long hours before a stack of films, or a screen, or at the controls of a deep therapy machine, attacking immediate routine problems of radiology in a busy clinic.

It is true that the qualified radiologist is the only proper person to be in full charge of the activities of the x-ray department. The future shall see the responsibilities increase. There would be unspeakable dangers otherwise, but, outside the great hospitals in the larger cities, radiologists have long since recognized many changes that are taking place. There is no fight on now for recognition of the importance of the x-ray in diagnosis or therapy. The days have passed since the radiologists were heaped with ridicule at medical meetings while discussing, for instance, the chest. My generation has witnessed some of that ridicule when radiologists were describing "fan-like densities and translucent areas" in the lung-fields.

Difference of opinion in regard to a diagnosis remains as it should remain, while we match our wits over the patients of our medical confrères, but public ridicule and scoffing shall never occur again except as they are deserved by the unskilled. It seems petty to even mention such things now, but my generation has seen radiologists purple with humiliation when they knew they were right. Our work with the x-rays now is a pure science only as medicine or surgery is a pure science, and as medical men we accomplish great things.

The future? The x-rays and radium have given and proven so much in the problems of medicine that no physician may conscientiously afford to disregard his duty to the patient by disregarding the use of radiology in diagnosis and treatment when needed to day. It is said that the general practitioner can well handle 80 per cent of his problems without the use of x-rays. It may be possible to say that he can *handle* pretty close to 100 per cent if he does not know his responsibilities, or if he is lucky enough to escape the courts in a malpractice fracture suit after setting a bone poorly without the use of available x-rays. Being personally satisfied with a diagnosis, without using all available assistance for a correct one, is one way of handling a patient, be it from the lack of a microscope, reagents for a urine examination, a blood pressure apparatus, x-rays, or stomach pump. But at this stage of advance in the science of medicine a physician's conscience should rest only when he has availed himself of every means at hand to get his patient well. Again, it seems needless to mention such things, but in considering the future for the x-ray specialist it would appear wise during these times of economic confusion to view many angles. The future of the radiologist has for many years depended upon the medical profession's understanding of when and how to use the skill of the radiologists. The radiologists have maintained high standards of ethics as knowledge has advanced. I think that most radiologists in the large medical centers to day examine or treat only those patients sent to them through a physician. At least, this has been my practice for some years while located near a large medical center. However, outside the large cities an entirely different situation must necessarily maintain. There may not be enough radiological work to support the radiologist and he finds himself working, along with it, in other and broader

medical confrères used to joke about them as being mutual admiration societies, but we were exchanging knowledge and getting somewhere rapidly. Our publications were centered chiefly in one x-ray journal. All that has changed and we have disseminated knowledge everywhere. The shadows of mystery have been cleared up, and the shadows of pathology remain. There are more x-ray demonstrations of pathology in medical and surgical journals now than in the few x-ray journals. The latter are largely archives for the splendid presentations made at the society meetings. I believe that as time goes on the "American Journal of Roentgenology and Radium Therapy" and RADIOLOGY should harbor more and more of those presentations as their greatest function and use.

I predict a closer bond between general medicine and the radiologists within the next decade and a half, with far greater revolutionary advancements in diagnosis and therapy accomplished than we have known in the past twenty years. We already see many men specializing within the specialty. To-day they are the ones contributing the masterpieces of writing which are consistent with the logical dignity and conservatism of advance in other special fields. Some of the older men have recognized the necessity of sifting out the chaff of many radiologists, who dash wildly here and there at every extreme so as to get into print.

It is an inspiring thing to watch many of the older men direct the activities of their heirs in radiology. Those pioneers in radiology have labored and lived to see the present zenith of excellence in the specialty, as it has been guided to great heights of accomplishment under their skilled hands, applied for such noble assistance in the various fields of medicine. Their records of accomplishment have been engraved into the annals of medicine throughout the world. The present position of radiology, as it exists in the closest co-operation with problems in all fields of medicine, could not have been guided by more skilled hands. So many have been noble martyrs in a great cause. We younger men following in their footsteps are thankful for their accomplishments, for, by their clearing the obstacles from the path that has led to the present successful and irrevocable attainments in radiology, we have been spared the heartaches and discouragements which they en-

countered as pioneers in establishing this specialty in its present enviable position of excellence in medicine. The quotation, "He is a poor pupil who does not exceed his master," does not apply here, for never again in the history of radiology shall opportunities in like form be presented.

To-day radiology stands well upon the threshold of opportunity for occupying a keystone position in an uncertain future trend of the economic development in medicine which is rapidly approaching. In this respect the future status of radiology, and in many ways the economic future of medicine, depend in no small measure upon the radiologists who are so intimately associated with the necessary field for advance. The future promises many changes from what the imaginations of our predecessors in medicine, who, through the generations established and maintained such splendid and unexcelled traditions, were able to conceive.

In therapy lies a great future for radiologists. It is bound to become an exclusive field in the hands of able pathologists. It is a great satisfaction to radiologists to realize the remarkable advance of knowledge they have had to grasp while treating neoplasms. My generation saw deep therapy announced for treating cancer with somewhat of the authority of the "Hax Pax Max" of mystic wizard fame. Money was not spared in installing the machines. We witnessed the percentage doses pass to the international r unit and logical reason. Nobly that great pathologist, James Ewing, and others struggled with us—encouraging here and there, ruthlessly ripping wide open many of our asinine ideas. I, with many others, travelled the continent, following the "will o' the wisp" cure for cancer. I spent all I had, to return a wiser and better man, attempting to settle down logically in radiology while the battle raged.

In therapy, my generation witnessed the practical entry of the ionization chamber and listened to the physicists expound it—most of which went over our heads. I recall the long silences following those technical eulogies. We rushed madly into ionization physics. We saw chambers modified by as many in number as there were physicists, with charts that would not agree, until finally came the international r. We then proved to the physicists that we had to remember the patient in terms of biological units. The physicists

at least one skilled radiologist out of a job. Young men interested in radiology know that such a type of radiologist, not fulfilling all his duties as a consultant, is in truth a skiagrapher either by choice or economic necessity and is regarded by most men on the staff as a skiagrapher first and a doctor last. During these hard times this skiagrapher may easily find a good radiologist for a hundred a month and take on still another hospital that decides it has too expensive a radiologist—one who has refused to be exploited. It is quite clear what this procedure is doing for the future of radiology, as lay business managers of hospitals are cutting to the bone.

As from year to year radiology has shouldered greater responsibilities in the rapid advance into all fields of medicine, the majority of staff physicians wish cheaper x-ray fees for the increasing needs of their patients and so they frequently combine to obtain it through the board and manager. Consequently fixed fees are becoming the established custom for the future, as has been the case for some time in the chemical or clinical laboratory. In most large hospitals I believe that the future shall see more radiologists placed upon a fixed salary and occupying somewhat the position of the laboratory men. The days of the personal lucrative private fees is nearly over in the public hospital x-ray department. A percentage of the net may last for a while but that soon shall pass. Of course, this is unjust.

It is my belief that the private outside x-ray laboratory must in time give way to the hospitals. The necessity for large fees to maintain overhead and install expensive new apparatus as needed is too great an undertaking for the younger man. If he undertakes it after a few years as chief of a hospital x-ray department, he runs the serious chance of losing his position on the staff, for the board and manager shall consider him as essentially a laboratory man and will not tolerate competition off-hand. Of course, this is an unjust attitude, but the staff usually does not make any active defense of the radiologist against the board and manager in such a situation, for too frequently the staff consider that it is to their interest to have more and cheaper service. It will become increasingly difficult for the private x-ray laboratory to compete with the hospital.

Physicians everywhere are becoming better educated to the use of the x-rays. Small, efficient, and cheap apparatus is here. There

are difficulties ahead for the physicians, but they will attempt to master them as they have had to master the microscope, the basal metabolism apparatus, and the electrocardiogram which have become available for private office work. They will not be the leaders in the x-ray world but they will be discovering much data and see things they never saw before, and from an instrument in their own hands. I believe that it is an excellent thing for them, and for the radiologists, because it will drive out those individuals unethically grasping too many hospitals. It will also educate the physician to the need for skill in the radiologic field.

My war generation had few texts on this subject at first, and x-ray articles were scarce. We saw gas tubes, cumbersome machines, and glass plates quickly pass out of the picture. We came into the field with knowledge of the dangers of burns. It seems but yesterday that high speed screens and films cut exposure time more than in half. Tiny self-rectifying units can now give excellent chest detail faster than one can open or close a switch. My generation saw the Potter-Bucky diaphragm enter the field, and we successfully speeded it up for stomachs, kidneys, and gall-bladder work. For good films, the days of romance and guess-work have passed. X-ray protection comes with the tube, and it is controlled otherwise easily and at will. Mechanical rectification soon is to become a thing of the past.

A medical student, these days, can pick out from the film a tuberculous infiltration the size of one's thumb nail in the upper lobe of a lung. We have all seen the most skilled of diagnosticians, with no knowledge of the film, miss such a lesion from an examination of the patient. We have seen such tiny spots grow from month to month until finally, after the loss of much valuable time, the clinician admitted they were there. Do you suppose the general practitioner has not found that out, and that we, as radiologists, in such a series of examinations can not declare definitely that active tuberculosis is there? Will the manufacturers give to these practitioners what they now wish, as Ford did to the public when he took luxury out of car-ownership? I think that they will.

My generation has seen more consistent and progressive enthusiasm in x-ray society meetings than has existed in the society meetings of any other medical group. Some of our

and last always in opposition to any future change from that unfortunate position into which many radiologists have been forced during the depression. Many of us who have refused to be exploited have fallen by the way-side.

With more post-graduate courses in radiology available at the teaching centers in this country, more post-graduate degrees in radiology could be conferred by the universities, but we have a long way to go in this country before adequate courses are established in sufficient number to supply the needs for skilled men. One has but to consider the average physician's woeful lack of knowledge concerning radiological diagnosis and therapy to realize that the establishment of more such post-graduate courses must be accomplished chiefly through the efforts of radiologists.

Lucrative fees have kept the heads of many prominent radiologists completely in the fog, but the field is too great for making a closed corporation out of radiology, as it suspiciously exists in some centers. The younger generation has had preliminary educational advantages far surpassing the groundwork possessed by many of my generation. Dissatisfaction among the younger men at the inability to find instruction or appointments is adding coals to the fire, as hospital managers cut the incomes of radiologists to the bone. The end is not yet. A great economic re-adjustment must come about, for radiology has leaped out of bounds.

My generation had nothing to do with bringing about the war and this cursed depression, but we are doing considerable thinking about it all and sometimes with bitterness. These are frightful and dangerous times of social cruelty for many millions of our people. The future of our social and political structure sways to the right or to the left each month as history is made. "Get what you can while you can get it" seems to be the slogan of the mob, as a stricken nation gropes about for relief and light. Never before in the history of this country have medical men had a better opportunity to carry out the age-old tradition handed down to them—that of placing the interests of the patients above their own. Radiologists have done this bravely during these times and have had little to say concerning many injustices meted out to them. As Pasteur and Lister contributed much to filling up the great unknown gap between the bed-

side and postmortem table, so likewise has Roentgen's discovery contributed much. One might well consider that, for the welfare of the world, the scientists in medicine in as many years of advance have contributed more than the inventors and industrial giants.

There may be considerable satisfaction for medical men in maintaining a dignified silence as the industrialists howl loudly now, following the catastrophe they have brought about, but at present those interested in the future advance of radiology in particular should heed the economic trends, obviously stifling more and more of individual initiative and indeed detrimentally influencing the future of this great special field of medicine.

An educational campaign for radiology is clearly indicated. Once or twice annually, in local x-ray society meetings, there should be a frank discussion of the economic trend in hospitals insofar as it affects radiologists. There should be more radiological contributions made to *medical magazines* other than those centered about radiology. Radiologists should take more interest and actively participate in all groups of medical society meetings. Public health problems, more particularly, the examination of school children, may open many avenues for widespread public education. Public education through the radio, and particularly information concerning the early diagnosis and treatment of cancer, is of importance. More effort should be made to participate in the activities of the hospital associations in which many laymen are interested. The radiologist's minority position on the hospital staff necessitates his becoming active in staff committees, and standing in closer contact with lay members of the hospital board. The lady board of managers or ladies committees are not to be overlooked, and the need for radiological endowments kept in mind. The future lies in the hands of the men to follow, so the hospital resident physician should receive the full concentration of the radiologist. In other words, there are opportunities for radiologists to participate in procedures in every field in which medical men are interested, for the best interests of the whole profession and the public.

The only way for physicians and others to receive knowledge of the intricate and difficult problems in radiology is through the radiologists. In such a position, the radiologist should possess all the requisites of the consul-

stole the show for a while, but now once again all is peaceful and calm

The future of therapy? It is the great unknown. Indications are that we have but just scratched the surface to day. We do not know the chemical mystery that takes place within the cell which may suddenly cause it to grow wild. I predict that some day it shall be known and that radiology, in combatting it, shall occupy the most prominent place. In neoplastic work, we, with the pathologists and biochemists, are the pioneers of to-day. We would like to live to see the great truth dawn. We, who receive the inoperables, would give thanks and there would be great joy.

As an important duty, there remains that we may see to it that the best of the younger generation enters this field. My generation has learned full well what we lack from the groundwork up. The medical staffs of the radiological departments of the great teaching centers must be increased, to enable young men to specialize within the specialty, or, otherwise, much from the radiological centers will be distributed to other special workers, who will use this method of diagnosis and therapy in more concentrated and narrow fields. With this in view, the teachers of radiology should urgently seek *exclusive endowments* for the chair and department, or radiology as a specialty will be absorbed. If many could see the light now, much future economic distress could be avoided; otherwise, there will follow a struggle for a subsidy from the general fund of the university for the purpose. In view of the uncertain economic trends in store for medicine as they exist to-day, I predict that soon, in the great teaching centers, the majority of the teachers in roentgenology will receive a fixed salary. It is regrettable, but I think that it is inevitable.

There is no longer any necessity for young medical men to receive their instruction and experience in radiology in a haphazard way, as many of my generation received them, as barnacles attached to a few of the pioneers. The universities should have more regular, endowed post-graduate courses in radiology. The British are far ahead of us in this, majoring physics, anatomy, physiology, chemistry, and pathology much more exhaustively than are required for a medical degree. The Cambridge course is the best of its kind in the world. As a member of the British Institute of Radiology, I have for many years carefully

followed their advance. They are a conservative lot of men. Their youngsters in radiology are being forced to the bottom of things. We shall hear much from them in the next few years. Until recently, the British radiologists faced an unprecedented depression, continuous since the war, as did the other radiologists on the Continent. They saw no boom days as did we in 1929.

At the British Institute of Radiology the visitor every day may see students reading in the radiological library filled with American, German, French, and Italian texts. Films in library form, under the care of a curator, are available upon all subjects—films sent by radiologists to this center from all parts of Great Britain. I do not know where such things may be seen in North America. In South America, yes—but not here. In Japan, one may spend many enjoyable days in a library of films, with courteous Japanese attendants ready to translate the concise and neatly printed records.

No one has ever listened much to the proposal I made years ago for an American Institute of Radiology in Washington with a museum, a librarian, and curator for films. I suppose the Cleveland disaster is still a mental hazard, though most of us use non-inflammable films. But I still believe that some day we shall have an American Institute of Radiology. Perhaps then a reprint service may be of great help to those of us not fortunate enough to be connected with a university service, where a well-paid staff translates and classifies the literature from various parts of the world.

The hospitals are profiting by the exploitation of many radiologists at present, but the time may come when the staffs of hospitals will be better educated in regard to the infinite detailed care and labor connected with *good* radiological work. Also, in regard to the need for patients paying a physician for such services at a rate commensurate with that received by our brother specialists in other fields of medicine. However, such an Utopia for the future appears doubtful. At present, it is frankly true that many of the staff unfortunately do not know the truth, and so radiologists of either mediocre ability or hopelessly in financial despair, are content to let the situation rest as it is—somewhat of the situation of "letting a sleeping dog lie." But time may change all that, though lay high pressure business managers of hospitals will be the first

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With more post-graduate courses in radiology available at the teaching centers in this country, more post-graduate degrees in radiology could be conferred by the universities, but we have a long way to go in this country before adequate courses are established in sufficient number to supply the needs for skilled men. One has but to consider the average physician's woeful lack of knowledge concerning radiological diagnosis and therapy to realize that the establishment of more such post-graduate courses must be accomplished chiefly through the efforts of radiologists.

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tant and share in all the responsibilities that the name implies

GEORGE U. PILLMORE, M.D.
Haverford, Pa.

ANNOUNCEMENT

AMERICAN BOARD OF RADIOLOGY

EXAMINATIONS

The Board will not be in session at the meeting of the American Roentgen Ray Society, but will convene at Detroit just preceding the meeting of the Radiological Society of North America. So many applications were on file that the Board was unable to consider all of them in its session at the meeting of the American Medical Association at Atlantic City in June, and some of them had to be deferred until the Detroit meeting. New applicants who wish to appear before the Board at Detroit will be considered in the order in which the applications are received, but only until the quota is filled, and the new applications should be on file at least sixty days before the meeting.

COMMUNICATION

MEDICAL SOCIETY OF THE STATE OF NEW YORK

SECTION ON RADIOLOGY

The One Hundred and Twenty-ninth Annual Meeting of the above Society was held in Albany, May 13-15, 1935. Donald S. Childs, M.D., of Syracuse, Chairman of the Section, presided, the Vice-chairman being L. P. Larkin, M.D., of Ithaca, and the Secretary being J. M. Flynn, M.D., of Rochester.

The papers presented before the Section were as follows:

"A Study of the End-results in the Treatment of Cancer Patients, with a Report of Approximately 400 Autopsies." Ira I. Kaplan, M.D., New York City. Discussion was opened by Angelo M. Sala, M.D., of New York City.

"Trichobezoar." Carlton F. Potter, M.D., of Syracuse.

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"The Relationship of Certain Technical Factors in the Roentgenological Examination of the Lungs." C. C. McCoy, M.D., of Coopers-town.

IN MEMORIAM

WALTER F. HENDERSON, M.D.

A member of this Society, Walter F. Henderson, M.D., of Jackson, Miss., passed away on April 18, 1935. He was graduated from Millsaps College, Jackson, Miss., in 1912, and from Vanderbilt University Medical School, Nashville, Tenn., in 1916. Dr. Henderson did post-graduate work in roentgenology at Tulane University, New Orleans, at Johns Hopkins University, Baltimore, and at the University of Michigan, Ann Arbor. He had practiced general medicine in Shreveport, La., previous to taking up the study of roentgenology, but after leaving the Army he devoted himself to that specialty. He became director of the roentgen department of the Baptist Hospital of Jackson, Miss., in 1925. He was well known in New Orleans, where he was director of the roentgen department of Touro Infirmary until compelled by failing health to resign.

Again, upon his return from the Mayo Clinic, where he went for operation for gastric ulcers, he resumed the directorship at the Baptist Hospital of Jackson. There his death occurred.

Dr Henderson was a member of his local, State, and national medical societies, as well as two fraternities. He has left many friends to mourn his passing, and his medical confrères have lost a capable young roentgenologist who gave promise of achieving still more notable work in his chosen specialty of roentgenology

ROBERT PAINE, M D

Robert Paine, M D, radiologist, recently passed away at the Methodist Hospital, Memphis, Tenn, following a week's illness with pneumonia. He was 43 years of age.

A native of Mississippi, Dr Paine attended Branham-Hughes preparatory school, Vanderbilt, and was a graduate of Jefferson Medical College, studied at the Crile Clinic, Cleveland, and had special courses at Massachusetts General Hospital, Boston, and at Harvard

Medical School. He also served two years at the Methodist Hospital, Memphis. He practised in Aberdeen, Miss, prior to coming to Memphis, where he became associated with W S Lawrence, M D, in the practice of general radiology.

Dr Paine served during the World War for two years as captain in the Medical Corps. He recently received a commission as a major in the Medical Reserve Corps. He was a member of the American Medical Association, Radiological Society of North America, Memphis and Shelby County Medical Society, Tennessee State Medical Society, Memphis Roentgen Club, and was an instructor in radiology in the medical department, University of Tennessee.

Leading members of the Memphis medical profession acted as pallbearers at Dr Paine's funeral, paying respect to their fellow-physician.

tant and share in all the responsibilities that the name implies

GEORGE U. PILLMORE, M.D.
Haverford, Pa.

ANNOUNCEMENT

AMERICAN BOARD OF RADIOLOGY EXAMINATIONS

The Board will not be in session at the meeting of the American Roentgen Ray Society, but will convene at Detroit just preceding the meeting of the Radiological Society of North America. So many applications were on file that the Board was unable to consider all of them in its session at the meeting of the American Medical Association at Atlantic City in June, and some of them had to be deferred until the Detroit meeting. New applicants who wish to appear before the Board at Detroit will be considered in the order in which the applications are received, but only until the quota is filled, and the new applications should be on file at least sixty days before the meeting.

COMMUNICATION

MEDICAL SOCIETY OF THE STATE OF NEW YORK

SECTION ON RADIOLOGY

The One Hundred and Twenty-ninth Annual Meeting of the above Society was held in Albany, May 13-15, 1935. Donald S. Childs, M.D., of Syracuse, Chairman of the Section, presided the Vice-chairman being L. P. Larkin, M.D., of Ithaca, and the Secretary being J. M. Flynn, M.D., of Rochester.

The papers presented before the Section were as follows:

"A Study of the End-results in the Treatment of Cancer Patients, with a Report of Approximately 400 Autopsies." Ira I. Kaplan, M.D., New York City. Discussion was opened by Angelo M. Sala, M.D., of New York City.

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DOSAGE

Measurements of the Distribution of Roentgen Rays for Short Focal Distances H W Ernst, Karl Frik and Paul Ott *Strahlentherapie*, 1935, 52, 389-402

In the last few years a number of investigators have reported encouraging results with the use of high doses of roentgen rays (heavily filtered) at short focal skin distance of from 2 to 10 cm in the treatment of superficially located malignancies. The authors studied, therefore the distribution of radiant energy in air and in the water phantom under these conditions. They found that the isodose curves could be changed at will by varying the F S D and the filter. Several examples were shown in the article, illustrating the fact that the distribution of radiant energy can be adapted to the location and size of the tumor. While the results obtained in water may be transferred without great error to tissue, it is not advisable to use such curves obtained with one apparatus on another without adequate calibration tests.

ERNST A POHLE M D Ph D

NERVOUS SYSTEM

The Effect of Light on the Development of Normal and Neoplastic Cells Grown *in vitro* A H Roffo *Strahlentherapie*, 1935, 52, 525-530

The author found that the susceptibility of neoplastic fibroblasts to light is greater as compared with fibroblasts in normal hearts of chicken embryos. A definite inhibition of growth was seen if the cancer cells were exposed to a 25 watt lamp with 2 per cent of 7,500 Å. Complete inhibition of growth was seen after exposure to a 40 watt lamp with 8 per cent of 7,500 Å. On the other hand, the fibroblasts in the heart of chicken embryos continued to grow even after exposure to a 100 watt lamp with 34 per cent of 7,500 Å.

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Functional Radiotherapy of the Sympathetic Nerves and Suprarenals in Vasomotor Sequels of Trauma R Desplats *Jour de Radiol et d'Electrol* November, 1934 18, 575 (Reprinted by permission from *British Med Jour*, Jan 12 1935, p 12 of *Epitome of Current Medical Literature*.)

The author has tried suprarenal radiotherapy in painful osteoporosis following injury in four cases. In all there was immediate relief of the pain, disappearance of the muscular contracture, and freeing of the joint movements progressive clearing up of the edema and loss of the feeling of heat, and the gradual terminating of the osteoporotic state. For this radiotherapy in fracture cases Desplats uses a dose of 250 r over each suprarenal region and repeats the radiation twice. There is generally a rapid improvement unless the fracture is of long duration when two or three series of exposures separated by intervals of three weeks may be necessary. This procedure should be

employed especially in cases of fractured neck of the femur, when convalescence can be shortened thus and any tendency to a resulting osteo-arthritis be checked. The vascular readjustment achieved by this form of radiotherapy is also effective in such conditions as traumatic arthritis, congenital dislocation of the hip, or the senile morbus coxae. Radiation in the suprarenal areas, with intervals of rest ends the pain usually by the third or fourth session, lessens any contracture brought about by muscular movement, abolishes muscular cramps, and diminishes claudication and, later on the extent of muscular atrophy. The author insists on the value of this distant radiation, though admitting that some of its results can be produced by local application of x rays. The action is primarily on the vasomotor conditions which accompany or follow the traumatic lesions, and the benefit is usually lasting.

PHYSICO-CHEMICAL EFFECTS

Physico-chemical Effect of Roentgen Rays on the Organism G D Lieber *Strahlentherapie* 1935, 52, 497-511

The author exposed neutral, positive and negative solutions of hemoglobin to roentgen rays (125 K V, 4 mm cardboard 300 H). Macroscopically, there were no changes in the test solutions. If neutral solutions were added to the irradiated neutral and acid solutions, they appeared to be more sensitive than the unirradiated controls. The irradiated neutral hemoglobin solutions showed a little more opacity than the controls, the sedimentation velocity was increased. In the acid sols these two phenomena were even more pronounced. Little effect was seen in the negative sol.

ERNST A POHLE, M D, Ph D

PNEUMOTHORAX

Artificial Pneumothorax J Arthur Myers *Jour Am Med Assn*, Oct 27, 1934 103, 1299

Itard coined the word "pneumothorax" in 1803 to designate the existence of air in the pleural cavity. Nature demonstrated that a lung may be partially or completely collapsed while the opposite lung carries on adequately the respiratory functions of the body. Observation revealed the fact that marked improvement of pulmonary disease occurred following spontaneous pneumothorax. These facts brought to light great possibilities in both the diagnosis and treatment of chest diseases.

The author discusses the method of administration, the complications, the effect on normal and on diseased lung tissue and the use of the method in diagnosis. He reviews its application to the treatment of pulmonary tuberculosis and touches on its use in bronchiectasis, pulmonary abscess and lobar pneumonia. The technique is given in detail. The complications are gas embolus spontaneous or accidental pneumothorax, serous effusion empyema mediastinal hernia febrile reaction pain and subcutaneous emphysema.

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CHARLES G SUTHERLAND M D

RADIUM

The Determination of Radium Isodose Curves in r, Corrections Based on New Experimental Studies
F Keller *Strahlentherapie* 1935 52, 403-424

An apparatus is described by the author which permits the calibration of radium screens in r. He states that gamma rays may be measured with ionization chambers in r (absolute) provided that the wall material furnishes the same number of photo-electrons, the same number of Compton electrons as air and that the electrons produced are absorbed at the same rate as in air. The measurements show that the results are definitely dependent on the thickness of the chamber wall. The amount of back-scatter in water or tissue depends also on the chamber wall material, the thickness of the wall, and the filtration of the radium. In no case was the back scattering equivalent to the amount of radiation absorbed. It is concluded that for every type of radium screen, special isodose curves in r must be determined in order to permit correct dosage.

ERNST A POHLE M D Ph D

THYROID (THERAPY)

The Radiologist and the Goiter Problem J W Cathcart *Texas St Jour Med* March 1935, 30, 703-706

From a series of 84 cases treated by irradiation—either x ray or radium, as the circumstances permitted—Cathcart believes that irradiation is of therapeutic value comparable to surgery in hyperthyroidism except when complicated by an excess size of the gland due to cysts or the presence of large amounts of fetal adenomatous tissue. He considers irradiation superior to surgery in adolescent enlargement with thyrototoxic symptoms when treated before the age of 20. Added advantages are the economic status during treatment, zero mortality from the procedure and the absence of pain and suffering.

WILLIAM A SODEMAN M D

TUMORS (DIAGNOSIS)

Mediastinal and Intraspinal Perineural Fibroblastoma (Hour-glass or Dumb bell Tumor) Removed by One stage Operation Stuart W Harrington and Winchell McK Craig *Jour Am Med Assn*, Dec 1 1934 103, 1702-1704

This is a case report of an hour glass or dumb-bell tumor in which the extra-spinal portion of the tumor was in the mediastinum and encroached on the adjacent intrathoracic structures. This involved the double surgical problem of combining the procedures for an intraspinal and an intrathoracic tumor. The tumor was removed successfully in one stage, the authors were unable to find record of this having been accomplished before.

Roentgenologic examination of the thorax disclosed a circumscribed shadow of soft tissue at the fifth and sixth ribs posteriorly on the left side. A localized roentgenogram of the spine revealed erosion of the pedicle of the fifth dorsal vertebra and upper border of the sixth on the left. The tumor was extruding through the intervertebral foramen between the fifth and sixth dorsal spines and into the mediastinum. The intervertebral foramen was eroded and enlarged by the extruding tumor. There was increase in width of the fifth intercostal space and erosion of the posterior inferior border of the fifth rib and posterior superior border of the sixth rib. A roentgenographic diagnosis of neurofibroma of dumb-bell type, invading both spine and mediastinum, was made.

Intratracheal anesthesia was administered with a positive pressure apparatus so that the intrapulmonary pressure could be controlled. The patient was transferred immediately after operation to the oxygen chamber, where she was kept for a period of ten days. Convalescence was uneventful and a letter received four months after the operation reported her condition as excellent.

CHARLES G SUTHERLAND M D

TUMORS (THERAPY)

The Treatment of Lymphogranulomatosis with High Doses of Roentgen Rays Franz Melchart *Strahlentherapie* 1935 52, 460-463

The author advocates the use of fairly high doses in the treatment of all involved glands in patients with Hodgkin's disease combined with general body exposure. The glands receive 200-240 r per area and three fields are given per day until the glands disappear. The total surface dose amounts sometimes to from 2 000 to 4 000 r for involved glands and 800 r for areas irradiated prophylactically. The general body exposure is carried out at 1-2 meters distance and from 50 to 100 r are given per sitting. As a rule the leukocytes drop down to 2 000 but they recover under As Fe medication and liver diet within from eight to twelve weeks.

ERNST A. POHLE M D Ph D

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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THYROID (THERAPY)

The Radiologist and the Goiter Problem J W Cathcart *Texas St Jour Med*, March, 1935, 30, 703-706

From a series of 84 cases treated by irradiation—either x-ray or radium, as the circumstances permitted—Cathcart believes that irradiation is of therapeutic value comparable to surgery in hyperthyroidism, except when complicated by an excess size of the gland due to cysts or the presence of large amounts of fetal adenomatous tissue. He considers irradiation superior to surgery in adolescent enlargement with thyrotoxic symptoms when treated before the age of 20. Added advantages are the economic status during treatment, zero mortality from the procedure, and the absence of pain and suffering.

WILLIAM A. SODEMAN, M D

TUMORS (DIAGNOSIS)

Mediastinal and Intraspinal Perineural Fibroblastoma (Hour glass or Dumb bell Tumor) Removed by One-stage Operation Stuart W Harrington and Winchell McK Craig *Jour Am Med Assn*, Dec 1 1934, 103, 1702-1704

This is a case report of an hour glass or dumb-bell tumor in which the extra-spinal portion of the tumor was in the mediastinum and encroached on the adjacent intrathoracic structures. This involved the double surgical problem of combining the procedures for an intraspinal and an intrathoracic tumor. The tumor was removed successfully in one stage, the authors were unable to find record of this having been accomplished before.

Roentgenologic examination of the thorax disclosed a circumscribed shadow of soft tissue at the fifth and sixth ribs posteriorly on the left side. A localized roentgenogram of the spine revealed erosion of the pedicle of the fifth dorsal vertebra and upper border of the sixth on the left. The tumor was extruding through the intervertebral foramen between the fifth and sixth dorsal spines and into the mediastinum. The intervertebral foramen was eroded and enlarged by the extruding tumor. There was increase in width of the fifth intercostal space and erosion of the posterior inferior border of the fifth rib and posterior superior border of the sixth rib. A roentgenographic diagnosis of neurofibroma of dumb bell type, invading both spine and mediastinum was made.

Intratracheal anesthesia was administered with a positive pressure apparatus so that the intrapulmonary pressure could be controlled. The patient was transferred immediately after operation to the oxygen chamber, where she was kept for a period of ten days. Convalescence was uneventful and a letter received four months after the operation reported her condition as excellent.

CHARLES G. SUTHERLAND, M D

TUMORS (THERAPY)

The Treatment of Lymphogranulomatosis with High Doses of Roentgen Rays Franz Melchart *Strahlen therapie*, 1935, 52, 460-463

The author advocates the use of fairly high doses in the treatment of all involved glands in patients with Hodgkin's disease, combined with general body exposure. The glands receive 200-240 r per area and three fields are given per day until the glands disappear. The total surface dose amounts sometimes to from 2,000 to 4,000 r for involved glands and 800 r for areas irradiated prophylactically. The general body exposure is carried out at 1-2 meters distance and from 50 to 100 r are given per sitting. As a rule the leukocytes drop down to 2,000 but they recover under As Fe medication and liver diet within from eight to twelve weeks.

ERNST A. POHLE, M D, Ph D

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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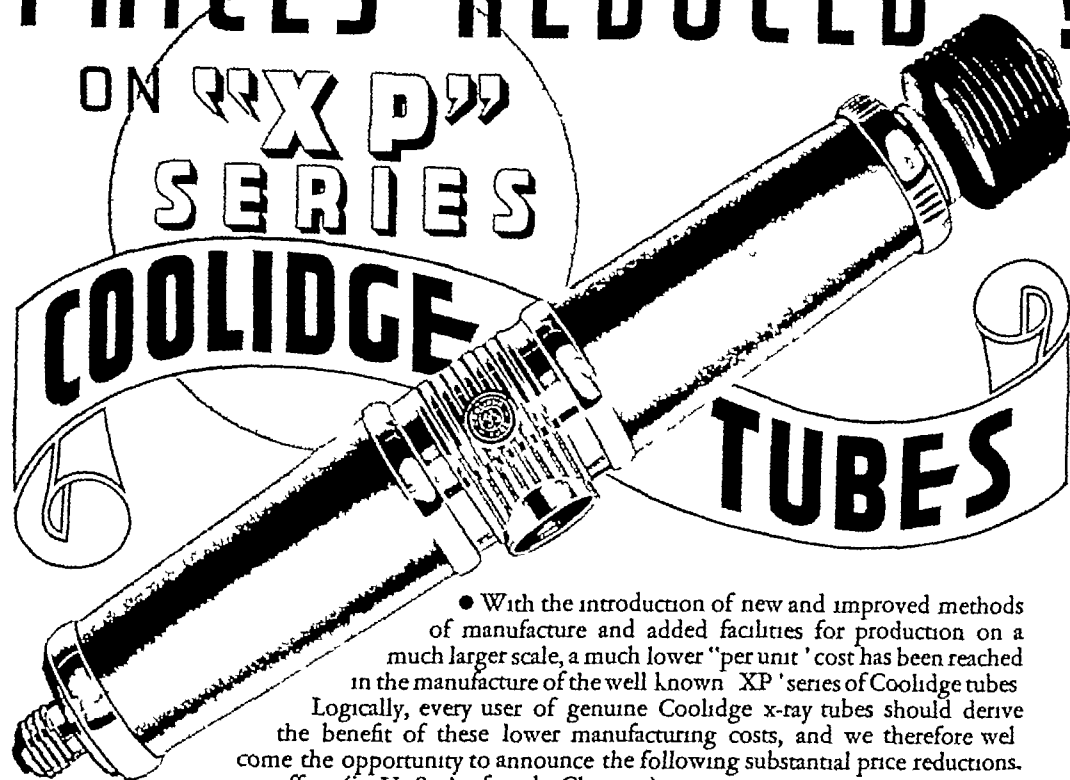
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